CHEMISTRY

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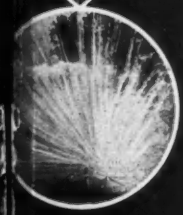

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50¢

A SCIENCE SERVICE PUBLICATION

Radiation Safety

➤ MILLIONS of curies of atomic energy are now ready for use in industrial processes. Technical industries look favorably upon putting this energy to work for them provided the proper safeguards can be used to protect workers, plant and product from danger. The Atomic Energy Commission is anxious to put its experience with radioactive materials at the disposal of manufacturers who want to try the experiment.

The source of this atomic energy is the store of fission products from the reactors at Hanford, Washington; Oak Ridge, Tennessee; and the newer installations as their nuclear "ashes" accumulate. These "ashes" consist of the solid material recovered from the solutions from which uranium and plutonium have been extracted. They are a mixed lot of compounds of the elements in the middle of the periodic table. Most of them are unfamiliar to anyone but an analytical chemist. Many are compounds of the rare earths, notoriously difficult to separate from each other. All are so highly radioactive that work on them must be done at a distance or behind thick shielding.

But the experience of the past ten years has yielded a definite body of information about what may and what must not be done by those handling radioactive compounds. Specific ways in which all common materials are affected by alpha, beta and gamma rays and by neutrons are known. Thicknesses of materials necessary to absorb these rays, either for obtaining useful effects or for preventing undesirable ones, can be provided. Instruments which sense and record radioactive effects are readily available.

We who are privileged to have seen the dawn of the atomic age can help our understanding of its problems by keeping in mind the analogy with the discovery of fire. Here, too, we must keep our distance and construct "fireplaces" of inert materials. But radioactive "ashes" remain "hot" for years, some for hundreds and thousands of years, and it pays to get whatever benefit we can out of this left-over energy.

If you decide to use fission products in your plant, you have several new units of measure to learn: wattage, electron volts, curies, roentgens and r e p. And, due to a clever packaging arrangement, you will receive your radioactive material sealed in 3 in. aluminum tubing and so standardized that you can buy it at so many curies per pound of contents or per foot of pipe.

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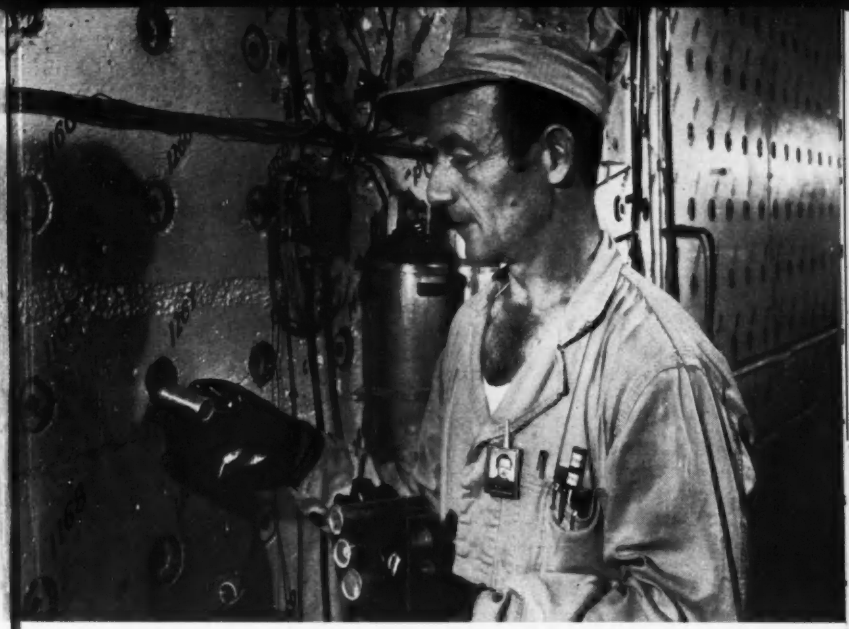

—Atomic Energy Commission photo.

➤ TEN POUNDS *of fuel, in the operator's hands, are being fed into the atomic furnace at Oak Ridge. The uranium is inside the aluminum tubes, one of which he is inserting into one of the holes in the face of the reactor.*

Atom-Power Machines

by HELEN M. DAVIS

➤ THESE are atom energy possibilities:

Electric motors could be run by streams of electrons from radioactive elements.

Fluidless batteries activated by air ionized by radioisotopes give off measurable current. When built of stable isotopes, these batteries become radiation detectors. Such batteries are already in existence.

New compounds now unknown, might be put together by energy which disintegrating elements give off. These are the subjects of current chemical research projects.

Such forecasts of possible new uses for atomic energy depend on the nature of the products of radioactive disintegration. They are more specialized than the rather obvious use of heat from the atomic pile instead of fire under the boiler of a modified steam engine.

Mysterious reports have from time to time suggested the possibility of new ways to use atomic power.

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Actually, the part that is new is rather the viewpoint of the user than any truly unknown power emanating from an atomic reactor. The puzzle is how to apply the unusual conditions available in the pile to produce some useful result that can not be accomplished by ordinary means.

The unique feature of an atomic pile is radioactivity on a large scale. Instead of radioactive disintegration products from milligrams of radium, with which scientists have been familiar for half a century, the pile gives off the products from pounds of uranium. Results are now possible that were not even dreamed of a short ten years ago.

Disintegrating atoms, whatever their nature, are capable of yielding three kinds of rays, distinguished as alpha, beta and gamma. Alpha rays are composed of helium hearts, particles of matter. Beta rays are composed of electrons, particles of electricity. Gamma rays are composed of photons, particles of radiation.

Naturally radioactive atoms always give off one or more of these rays. Artificial radioactive disintegrations, such as are induced in the atomic pile, yield also other kinds of atom fragments. Some of these are the radioisotopes now coming into extensive use as tracer elements and as sources of radioactivity for medical use.

Another product of the atomic reactor is the neutron. This is a material particle, predicted on theoretical grounds in 1920 but unknown until it was discovered in 1930-32 through experiments with radioactive material.

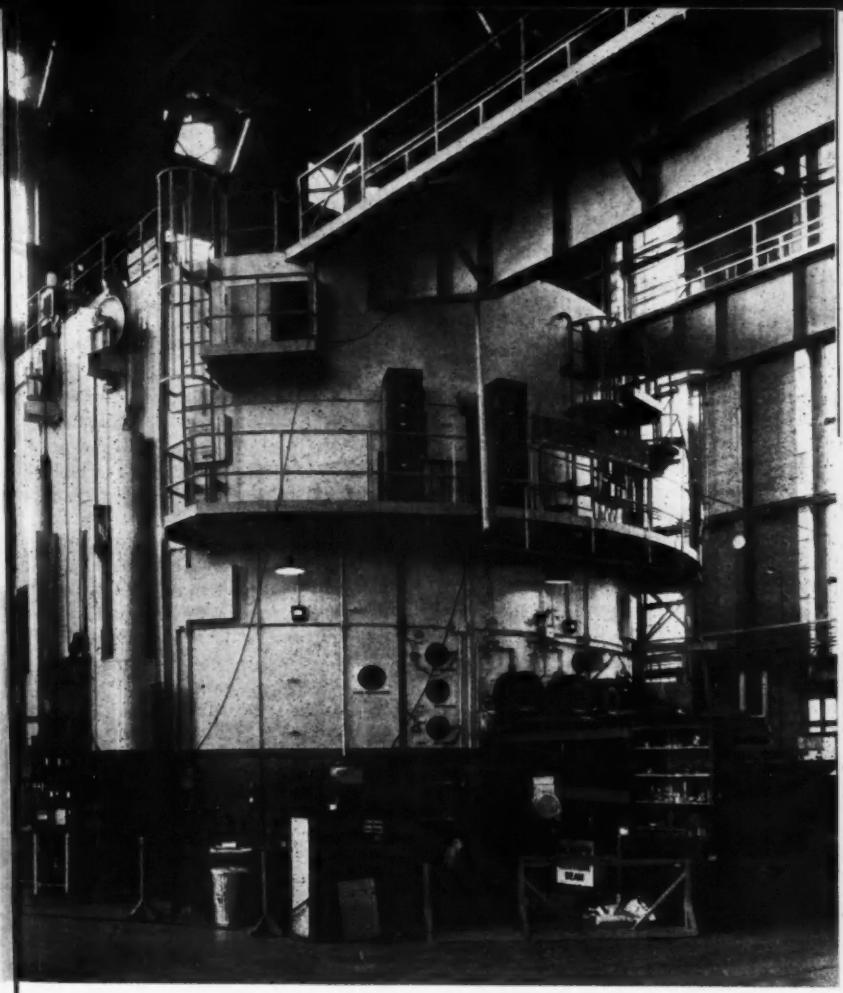
The chain reaction of the atomic pile operates by means of neutrons. They set off the fissions of uranium 235 atoms, which produce more neutrons, which set off more fissions. Therefore the atomic pile can be operated as a source of neutrons. Any chink in the wall of a pile lets out a neutron beam.

As particles of matter, neutrons form a chemically inert gas, lighter than helium but somewhat similar to it.

As materials to work with, the nuclear chemist thus has, besides the miscellaneous radioisotopes, four standard resources. These consist of a beam of radiation (gamma rays) and a beam of electricity (beta rays) and two kinds of matter (alpha rays and neutrons), both chemically inert but capable of causing nuclear rearrangements in other elements. In addition, the pile develops a quantity of heat which represents the excess energy let loose during its operation.

One of the obvious ways to get useful work out of these conditions is to use the heat. Heat engines have been known for some two thousand years, and employed to do useful work for about the past two hundred. It would seem that hitching a steam engine to the atomic reactor and putting the heat to work would be a simple engineering job.

Here, however, the dangerous properties of radioactivity call a halt. The human body can take a certain amount of radioactivity in its environment and never know the difference. At the levels produced in the atomic pile, however, radioactive products disrupt life processes and make it impossible for the individual exposed to them to survive. Men working around the pile have to be protected by shields of lead or concrete, both materials



--National Research Council, Ottawa, Canada, photo.

▶ THE CANADIAN *NRX pile taken from the east corner of the building. On the right are the experimental holes through which beams of neutrons are available for experiments. On the left is the south thermal column, also used for research.*

which, when built up into thick enough walls, keep radiations from getting through.

Materials differ greatly in their power to stop radiations. Some, instead of stopping them, absorb them and themselves become radioactive, acting as new sources. Water has this drawback.

Water, also, cannot be circulated through the pile and then used to drive a steam engine, because the heat of the pile does not make it hot enough. It is the drop in temperature which controls the efficiency of a steam engine. Some other material must be heated hotter than the boiling point of water to make steam to run a turbine in order to drive machinery with the heat from the pile.

The chemist, however, has many materials at his disposal. If one cannot be used for some purpose, he looks around for another with similar properties to substitute for it. In this case, he needs a liquid which can be pumped through some kind of pipes without too much trouble from corrosion, and put through a heat-engine cycle or a heat-exchange circuit to obtain useful work.

The element sodium seems at the present time to be favored for the role of the heat engine liquid. Although a metal, it melts close to the temperature at which water boils. It cannot be allowed to come in contact with air, for it reacts violently and catches fire in the presence of both air and water, but, so long as it is closed up in a system of pipes, that danger can be disregarded.

One of the dilemmas facing designers of atomic heat engines has to do with the difference between heat and temperature. Although a great deal of heat is generated by the operation of the pile, the temperature does not rise high enough to liquefy most metals. This is one factor in the choice of sodium for its heat engine job.

An entirely different property of metals is responsible for one of the new applications of atomic energy mentioned earlier. This has to do with the fact that a difference of electrical potential appears when two unlike metals are joined by some material capable of carrying electrons from one metal to the other.

This is one of the earliest electrical phenomena recognized. It is the basis for Alessandro Volta's battery, constructed about 1800. Volta used alternate layers of tin or zinc and copper or silver, each pair separated by a piece of wet cardboard or leather. But, Volta was careful to note, his simple apparatus worked best when he added salt or lye to the water. The explanation that the material he added supplied ions to transport the electrons from one metal to the other was not made until long after his time.

A later development of Volta's battery used sulfuric acid for the liquid between the two metals, an electrolyte still in use in the storage battery of today. Other present day batteries, notably of the Edison type, use an alkaline solution, a continuation of Volta's lye. But all these, even the so-called dry-cell, which is really "moist," depend upon some liquid to transport the ions.

It remained for today's supply of radioactive materials to make possible the fluidless battery. Such a device was reported to the Atomic Energy Commission in September 1950 by

Philip E. Ohmart, who was at that time at the Mound Laboratory of the Monsanto Chemical Co., Cincinnati, Ohio. The report has recently been announced in the Commission's Nuclear Abstracts, and Ohmart has meantime formed his own company in Cincinnati to manufacture radiation-detecting devices based upon his discovery. Ionized gas is the medium he uses to carry an electric current between two dissimilar metals.

The power to ionize the gas comes, in one form of this electric cell, from a radioactive isotope built into the cell in one form or another. Radiations given off by this isotope lend an electric charge to particles in the air between the two metals, usually lead and gold, which form the plates of the battery. A small galvanometer indicates the amount of current that flows between them.

The amount of current from such a battery is actually very small, and the inventor makes no claim that his radioactive batteries will start cars or take the peak load of power lines. He adapts the principle to a purpose for which other batteries would be useless. By building the cell entirely of stable isotopes, and filling it with an inert gas such as argon, he makes sure that the battery gives off no current except when radioactivity from some outside source ionizes the gas sealed within. The lead-gold battery thus becomes a radiation detector which needs nothing but its own natural potential between the two kinds of metal to generate its indicating current.

Ohmart has built cells of many shapes, sizes and designs, using a variety of metal pairs, until he is satisfied that the metals behave essentially in the same way that they do in conventional batteries. He can make certain variations in the designs and materials of the cells to adapt them for detection of alpha, beta, gamma or neutron radiation. By other quirks he can make gas-filled batteries which will analyze alloys, measure the rate of growth of surface films and oxides, measure vacuum and pressure, measure humidity and analyze gases.

All these are developments that have come about because of atomic reactors. The cells may be thought of as atomic batteries, because radiation strong enough to bring out their flow of steady direct current comes only from atomic energy. Who can say what future applications may be made of this ionizing power, now largely unused?

Another direction from which better utilization of atomic power can be expected is also connected with ionization. An ion is essentially an atomic particle carrying an electric charge. How it gets the charge was for a long time a mystery, but the confusion was largely in the minds of those who thought of the world as a static place. Once they had accepted the idea that small particles of matter are in constant motion, the picture of these atomic entities gaining and losing electrons and carrying them from one battery pole to the other became much simpler.

According to our present understanding, these atoms which are in constant motion are like clouds of electrons revolving planetwise around a strongly attracting central nucleus.

We say that the nucleus is positively charged, and that the electrons are units of negative electricity. Electrons revolving in orbits close to the nucleus are attracted so strongly that only a strong disrupting force, such as collision with a neutron, can disturb their equilibrium.

Electrons at the outer surface of this cloud, however, are not held in their orbits as strongly, and may be brushed off or picked up by passing ions of other materials. Events of this kind are constantly happening in the crowded universe in which atoms move.

Atoms with their full complement of electrons are electrically neutral. One which has lost an outer electron is said to have a positive charge, because the positive charge of the nucleus is greater than the amount of it balanced by the electrons it is holding at the moment. This positively charged ion will move toward any negatively charged particle within its range.

Similarly, an atom which has picked up a stray electron and acquired a negative charge will move toward a positively charged particle in its neighborhood. When a positive and a negative ion meet, there is a tendency for them to join forces, share the outer electron and be thus transformed into what the chemist calls a molecule of a compound substance.

The joining of a positively charged and a negatively charged ion is not, however, as simple as it would appear. Each of the ions is a miniature three-dimensional solar system composed of rapidly spinning and revolving units held together by the equilibrium of balanced forces. Conditions must be just right for these two sets of motions to mesh. Chemists speak of the energies necessary to effect such combinations.

Here atomic energy brings a new factor into chemical combinations. Chemists have from time to time been surprised to find that material irradiated in an atomic pile came out in a different chemical form than it went in.

This would not surprise the nonchemist, perhaps, who might assume that in an atomic reactor almost anything might happen. Actually, however, nuclear rearrangements are amazingly regular. A neutron shot into the heart of an atom is absorbed, a rearrangement takes place, and the resulting products appear with their chemical properties intact, even though their nuclei may be in a highly unstable radioactive state.

Chemicals combinations take place among the outer electrons. Elements differ in the number of electrons they can gain or lose at the surface. Theoretically the number may be as many as seven. Some elements usually lose or gain pairs of electrons, or even triplets. Many elements form series of compounds which differ in their properties according as one, two, three or more surface electrons are involved in their formation. Each of these compounds has its own energy of formation. Many elements also have the ability to combine with two or more other elements into complex compounds. Characteristic energies also go with each of these combinations.

When the chemist irradiates a compound of two elements, and modifies

the nucleus of one, or perhaps both, he expects that the resulting material will reappear in about the same kind of combination that it was in before.

When he finds, as occasionally happens, that oxygen has been added, and the resulting combination has been formed because of the atomic energy available in the pile, he begins to recognize a new source of chemical compounds, possibly of some that are difficult to produce with energy sources more commonly available. Perhaps he can put ions together in a new way to make some compound never before produced.

Another possibility also comes to mind. Combinations with the halogen family of elements, fluorine, chlorine, bromine and iodine, are spectacularly dependent on the energies available. This is well illustrated by the familiar experiment in which hydrogen and chlorine are mixed in the gaseous state. Kept in the dark, no reaction takes place. Put into diffused daylight, they combine gradually into hydrochloric acid. Set in a beam of sunlight, they combine with explosive violence.

The difference is in the amount of energy furnished by the radiation we see as light. There are other radiations, notably gamma rays. Utilization of gamma rays from radioactivity for halogenations seems to open another power source from atomic energy. Chemists are fairly sure that, as soon as they begin to experiment along similar lines, other examples of this kind of triggering reaction will be found.

In another field, chain reactions of a different kind than nuclear fission are remaking the kind of materials

—Brookhaven National Laboratory photo.

➤ COBALT 60 *is the 1000 curie source which took its own picture. Light for this time exposure came from water fluorescing under gamma rays.*

we use every day. Organic compounds, formed from carbon, hydrogen and a few other elements, do not usually form ions, but have a somewhat different way of sharing electrons. They are capable of joining together to make very large molecules, and again some of these can combine into supermolecules, which form the products known as polymers and the materials known as plastics.

Understanding the processes by which polymerization takes place is a recent accomplishment for the chemist. An important key to these processes is the energy required to set them going. Once started, this type of chain reaction tends to keep on, drawing together all the available material into the polymerized state. Bits of radioactive material have in some instances been found able to start such chain reactions. Here again is a use for atomic energy as yet untapped.

Scientists who work for the Atomic Energy Commission are very conscious of the possibility that many new uses can be found for radioactive material. They recently commissioned the Stanford Research Institute to survey such uses, both those already in operation and those which as yet are barely within the limits of what might be. Results of this survey have just been published.

"Considerable study," this report states, "has been devoted to the effect of radiation on materials, usually directed at finding methods of preventing unwanted chemical effects. In such work, extensive information has been gathered about the free radicals formed by the absorption of radiant energy. Very little effort, however, has been devoted to seeking chemical reactions which may have industrial value."

Among uses already being considered for atomic radiations are those that make use of their power to kill. Cold sterilization of drugs, such as penicillin, and of perishable foods, and destruction of insect pests in packaged food offer a large market at the present time for using beta and gamma rays given off by atomic fission products.

"Many of the fission product applications," the Stanford report points out, "are based upon the use of ion pairs formed by beta and gamma radiations. Beta radiations could best be used when gas ionization is desired. Gamma radiation would be most effective in ionizing liquid and solid materials."

Fission products are the miscellaneous lot of atomic by-products collected during the operation of the atomic energy reactor. Strontium 90 and cesium 137 are prominent among them, and they include many other elements whose uses are as unfamiliar as their names. One peculiarity is that fission products are beta-emitters, some giving off gamma rays as well. For alpha particles, users still have to employ radium or polonium.

Isotope, as the word is used at the atomic energy laboratories, refers to the pure isotope of a single element, obtained either by separation by magnetic or diffusion processes or by irradiation and transmutation of a different element. Fission products are also, of course, isotopes of their respective elements, but they are processed rather for their radioactive than for their chemical properties.

One large market already being developed for gamma ray sources is for testing materials without destroying them. This is much the same as taking X-ray photographs. Cesium 137 is the fission product especially useful for this purpose. It would compete not only with X-rays but with radium and with cobalt 60. The Stanford group finds, however, that the differing properties of these materials assures special uses for each and enough demand for all. An instrument which will give an instantaneous direct reading of a radiograph is, they feel, all that is needed to open a large commercial field for instruments of this kind.

Beta ray sources are being studied for use in a variety of applications. One is as a static eliminator. Ions produced in the air by radioactive material would allow static charges,

such as accumulate on machines handling paper or certain plastics, to leak away.

Another use is to speed the lighting-up time of fluorescent and other gaseous discharge tubes. A little strontium 90 in such a tube would keep the small amount of gas in it in a permanent state of ionization. A somewhat similar use for this element is to activate phosphors to keep self-luminescent signs and markers glowing. The radioactive material would not be completely safe to use in the open for such a purpose, but it, along with the phosphor, can be sealed into a plastic container, which holds back the radiation but allows most of the light to come through.

Less obvious ways to use the properties of beta-emitters include aids for grinding to small particle sizes and for improving flame propagation rates.

One of the most interesting suggestions resulting from the Stanford study is the possibility of producing a small electric motor-generator operated by the stream of electrons from a pure beta-emitting fission product.

It seems obvious, therefore, that an atomic pile is much more than a furnace. With so many new possibilities opening up for the use of atomic energy and its by-products, the day may be not too far distant when constructive use of atomic power may make its employment as an explosive obsolete.

On the Back Cover

➤ NEWEST SOURCE *of power in the world is the nuclear reactor where atomic fission gives off atomic energy. Lifted above the floor on a huge elevator, these men are removing plugs from some of the fuel openings in the shield of the Oak Ridge pile. They will insert new charges of uranium, pushing them into the interior of the structure with the ten-foot steel rods shown in front of them. As a rod is inserted into a channel, another rod is threaded to it, increasing its length to permit traversing the length of the fuel channel. The photograph by J. E. Westcott is from the Atomic Energy Commission.*

Sea Water "Born" 200 A.D.
Gives New Ice Age Theory

Radiocarbon Dates Ocean Deeps

A GREAT MANY years from now — perhaps 40,000 to 4,000,000—temperate climate may return to the polar regions. Our globe will emerge from the Ice Ages which are not now quite over.

The surprising discovery of 1,600 and 1,750 year ages for Atlantic sea water at depths of one to two miles gives rise to this speculation.

By measuring the radioactivity of the carbon isotope 14 in the carbon dioxide in deep sea water ingeniously sampled from just above the ocean bottom, Dr. J. Lawrence Kulp, Columbia University geochemist, determined its unexpected antiquity. It won for him the 1951 Newcombe Cleveland $1,000 prize awarded by the American Association for the Advancement of Science.

The extreme sluggishness of the ocean circulation is proved by the new age figures. The water dredged from the ocean depths in north latitudes 53 and 58 started its submarine migration about 200 A.D. when it was at the surface of the arctic sea. Its carbon 14 exploding atoms were then manufactured by cosmic rays bombarding atmospheric nitrogen and washed by rain to earth and sea. Dr. Kulp demonstrated this by delicate measurement with a "radiocarbon calendar," a Geiger counter device that he has refined until it measures ages up to 30,000 years whereas 20,000 years was the previous limit.

The ancient water took centuries to travel toward the equator and will take even longer in its further journey southward. Dr. Kirtley F. Mather, Harvard geologist, who is president of the A.A.A.S., explained that this slow circulation is a refrigerating system for the earth, carrying polar cold to tropic regions.

But he speculated that in the stretch of geologic time this circulation could be reversed. The sun's tropic heat would evaporate the equatorial water, increase its salt content, cause it to sink even if it were hotter than the deep water. Finally the oceanic circulation would be reversed, tropic heat would be carried to the poles and warm climate would come to the arctic and the antarctic. Geologists have found fossil ferns in Greenland and evidence of ancient forests in Antarctica. Eons from now such conditions may return.

To aid such earth theories, Dr. Kulp and his fellow scientists at Columbia's Lamont Geological Observatory directed by Dr. Maurice Ewing, are enlisting the further cooperation from the Woods Hole research ship, Atlantis, and the U. S. Hydrographic Office's vessel San Pablo. Each of these in two summers got a deep sea water sample.

Large cylindrical tanks, holding 300 gallons, were sent down to 10,000 feet, sealed shut there and then hauled up. The carbon in this water was tested for age, by chemical and atomic processing. The radiocarbon dating was by the method worked out by Prof. W. F. Libby of the University of Chicago, but Dr. Kulp was able to shield the counters used with a ring of mercury that eliminated more background radioactive "noise" and this increased the measurable age span.

Possibly the new knowledge of the depths of the sea will help submarine signalling and detection of military significance, but the scientists are actually much more interested in new facts about the mysterious past of Mother Earth.

Danger of Tank Explosion Lessened

➤ ELIMINATION of the danger of aircraft fuel tank explosions when hit by an enemy bullet is predicted by experts at the Royal Aircraft Establishment, Farnsborough, England, Britain's aeronautical research center. They have developed a promising device for the purpose, which is under test.

Such explosions are due to the fumes that rise from the gasoline in a fuel tank. When a bullet passes through them fire and explosion may occur. The new device releases a gas within the tank which stops the fumes from acquiring enough pressure to explode. Their device is an orange-size gas-bomb, filled with carbon tetrachloride, that is placed inside the tank. It is triggered with a sensitive diaphragm and releases its contents when the pressure accompanying an explosion is just starting. The gas released is scattered into the explosion and stops it before the pressure is three pounds per square inch.

Scientifically speaking, these experts say, an exposion is slow in getting started if measured in milliseconds, that is in thousandths of a second. There is a pressure rise of one-half pound per square inch in the first five milliseconds. The pressure is 100 pounds in 50 milliseconds. An explosion can be stopped after it begins, they believe, by letting off a gas-bomb inside the explosion a split-second after it begins so as to prevent this build-up in pressure.

The new principle does not prevent the fumes from forming or the explosion from starting. If a bullet should hit the fuel tank the explosion begins. But it is detected by the sensitive diaphragm in the first few thousandths of a second. The diaphragm operates the bomb releasing the suppressor-gas. The build-up of pressure is stopped, and also the explosion.

Tests already made indicate that this process is successful. Bullets fired through an unprotected fuel tank caused explosion. When bullets were fired at tanks with the "explosion-suppression" bombs inside them, they rocked as the bullets hit them but no explosions resulted.

Glass cloth draperies for windows are non-transparent, unharmed by sunlight, rain or mildew, and will not catch fire.

New Sleeping Medicine. Other Chemical Aids

New Drugs Promise Help

➤ BECAUSE some laboratory mice unexpectedly took naps and an alert girl technician recognized something out of the routine, doctors now have a new, apparently safe sleeping medicine for the millions of patients bothered by insomnia.

The new sleeping medicine is called Dormison by its manufacturers, Schering Corporation. Its chemical name is 3-methyl-pentyne-ol-3.

Good results with it in 134 patients who previously had to take barbiturates to sleep are reported in the Journal, *Science,* by Schering Corporation researchers S. Margolin, P. Perlman and F. Villani and Dr. Thomas H. McGavack of New York Medical College and Metropolitan Hospital.

Most of the patients fell asleep in less than half an hour after taking capsules of this medicine. They had a restful sleep and no "hang-over" upon awakening. A number have been given daily doses of the chemical for more than five months without any adverse effects. Laboratory tests showed no harmful changes that could be attributed to the drug.

Dormison is not a pain-reliever. It is the kind of chemical called a hypnotic, but is not related to any presently used sleeping medicine.

Its accidental discovery came about during research on the anti-arthritis remedy, coritsone. Schering chemists had isolated a fragment of the cortisone molecule which they thought might be the active anti-arthritis part of the chemical. This fragment was given to mice to test its possible toxic, or harmful, effects.

The mice immediately went to sleep. It was the kind of deep, hypnotic sleep that usually precedes their death. But to the surprise of Miss Marie Doyle, the technician who was watching them, the mice woke up, frisky and apparently rested. Miss Doyle reported her observations and the experiment was repeated. The results were the same and the Schering scientists realized that their chemical from cortisone might be a useful sleeping medicine.

Extensive testing showed that the drug is effective in inducing sleep, is apparently safe, and, so far as is known from trials to date, is not habit forming.

The effects of an overdose can be counteracted by coffee, if the patient can be aroused to drink it, or by injections of caffeine.

Dormison is now available on a doctor's prescription.

Drug Makes Abstainers

➤ SOME 2,500 alcoholics have gone on the wagon permanently and another 1,250 have made "basic improvement" through treatment with Antabuse, Dr. John Jewell, medical director for Ayerst, McKenna and Harrison, Ltd. stated recently.

Dr. Jewell's statement covered reports from more than 100 clinics in

the United States and Canada on over 5,000 patients. The tests have been going on since 1949 when Ayerst introduced the drug in this country.

Antabuse, termed "the drug that builds a chemical fence around the alcoholic," is now available for general prescription use. Chemically it is known as tetraethylthiuram disulfide. Its anti-alcoholic action was discovered by three Danish scientists, Drs. Erik Jacobsen, Jens Hald and O. Martensen-Larsen.

The drug is taken as a small white tablet to be swallowed. Taken alone in proper dosage it produces no reaction. But if the patient takes even small amounts of alcohol while under Antabuse treatment, he is afflicted by intense flushing, perspiration, difficulty in breathing, palpitation and nausea. The reaction is so unpleasant that the patient stops drinking.

Antabuse is intended for use under close medical supervision. While the patient has this "chemical fence" around him, treatment for his underlying emotional difficulty which led to excessive drinking can be given effectively.

Chemical for Broken Bones

➤ BROKEN bones can be set faster, the period of pain and discomfort for the patient is shorter and recovery comes sooner when a chemical called hyaluronidase is injected.

The chemical, an enzyme known also as the "spreading factor," permits rapid diffusion of liquids through the body because of its ability to break down hyaluronic acid, an important component in the jelly-like mass which holds cells together in tissue.

In the case of broken bones, it acts to reduce pain and swelling quickly by causing wide dispersion of the edema fluid and the accumulation of blood, seen by the patient as black and blue spots. As a result, a snug fitting cast can be put on at once, instead of after a period of waiting for the swelling to go down.

This and four other medical uses of hyaluronidase are shown in a new medical motion picture produced under the direction of Columbia University College of Physicians and Surgeons, New York, by Wyeth Incorporated, drug manufacturing house of Philadelphia.

Medical studies with patients recounted in the motion picture also show:

1. That hyaluronidase added to irritating drugs such as liver extract, steroids and concentrated vitamin preparations, usually injected intra-muscularly, decreases discomfort and local tissue damage in patients.

2. That hyaluronidase, combined with local anesthetic agents, markedly shortens the time of onset of anesthesia and produces an area of anesthesia roughly three times larger than with the agents alone.

3. That hyaluronidase added to procaine for purposes of blocking the mandibular nerve in oral surgery and dentistry causes the fluid to be diffused almost immediately to the complete circumference of the nerve, thereby shortening the waiting period for complete anesthetic effect.

4. That a ring which acts as a tourniquet about an injured finger may be removed without cutting.

New Morphine Antidote

➤ A NEW local anesthetic, a new chemical antidote to poisoning by morphine and other opiates and a drug to stop vomiting after operations were announced at the Washington meeting of the American Society of Anesthesiologists.

The new local anesthetic is 2-chloroprocaine. It acts faster and results are longer lasting than with procaine, an older local anesthetic. It was reported as a very promising agent for blocking pain nerve fibers in just one region of the body. Drs. Francis F. Foldes and Pearl G. McNall of Mercy Hospital, Pittsburgh, and the University of Pittsburgh School of Medicine reported on this one.

The new antidote, or antagonist, to opiate drugs is N-allynormorphine. Given to patients who had had large doses of morphine or demerol, it gave dramatic stimulation of breathing and circulation, Drs. James E. Eckenhoff, George L. Hoffman and Robert D. Dripps of the University of Pennsylvania Hospital reported. It can also couneract the effects in babies of the sedatives given the mothers in childbirth.

The anti-motion sickness drug, dramamine, reduces vomiting after operations 50%, Drs. Daniel C. Moore, LeGrande Anderson, Gordon Wheeler and John Sheidt of Seattle reported.

Resin From Cotton Plant

➤ THE WAY has now been opened for the elimination of "tar spot" blemishes in cotton fabric. These imperfections annually cost textile mills many hundreds of thousands of dollars.

It has always been a mystery just where the "tar spots" come from. For years scientists in mill laboratories, colleges and research centers have been pushing toward a solution to the mystery.

Now, Dr. Jack Compton, technical director of the Institute of Textile Technology in Charlottesville, Va., reports that a discovery by Leo Hubbard, ITT research chemist, proves beyond doubt many of the "tar spots" come from tiny resin sacs of vegetable origin.

These sacs are normally present in leaves or burrs which get mixed with cotton fiber during harvesting. These tiny egg-like capsules, about one-fiftieth of an inch in size, often are spun right into a piece of yarn and woven into the cloth.

When heated, they burst and a black substance resembling tar flows out to cause a smudge. Ordinary bleaching operations cannot remove the stain, because this resinous substance will not dissolve in petroleum solvents.

Until this new discovery by textile scientists here, it was believed that all "tar spots" resulted from flecks of tar or asphalt picked up by cotton during its journey from the fields to the spinning mills. Hence the common name, "tar spots."

Dr. Compton says that while some of the spots which plague the manufacturers and the customers alike are caused by asphaltic materials, a great many also come from the tiny resin sacs of vegetable origin. This discovery, he says, opens a new way toward eliminating the problem completely.

Some Metals Hurt Plants, Others Are Useful to Man

Unusual Metals in New Roles

➤ PLANTS are not always so smart. They sometimes commit suicide or injure themselves.

Certain minerals, about 15 of them, are essential for proper plant growth. But often plants take up the wrong ones, Perry R. Stout of the University of California's College of Agriculture finds.

For example, in laboratory experiments it has been shown that strontium which is not essential will be absorbed by plants. Strontium is about the same size as calcium, an essential plant food. If a plant takes up this strontium, it becomes deficient in calcium and cannot grow normally.

Similarly, it has been shown that molybdenum, if present in large amounts, is taken up instead of essential sulfur. Plants need a small amount of molybdenum, but sometimes so much is taken up that it poisons livestock. In low sulfur soils where large amounts of molybdenum are present, enough molybdenum may be taken up by the plant to injure it.

Often two essential minerals such as calcium and magnesium will compete to be taken into a plant. If magnesium is relatively high in proportion to calcium, it usually wins out causing a calcium deficiency. The plant cannot tell the difference until the magnesium gets up into the stem and leaves. Then it is too late.

Magnesium Protects

➤ A COMPLETE system of buried bars of magnesium, to prevent the underground corrosion of structural steel, steel piping and electric lead-sheathed cables, will be installed at the new Fairless Works of United States Steel Corporation, at Morrisville, Pa.

These bars of magnesium will provide what scientists call cathodic protection, a widely used method of setting up electric currents to offset the natural currents that cause underground corrosion of metals. Such corrosion is of common occurrence and does much damage each year by causing the failure of underground cables and piping and weakening steel construction that extends down into the earth.

When dissimilar metals are in electrical contact and are placed in a conductive liquid or in the moist earth a natural current is generated between them and flows from one to the other. This current flows from the metal which by its nature corrodes most to the one that corrodes least. It causes the less stable metal to disintegrate or decay. The action is electrolytic, similar to that in the electroplating process.

Much scientific work has been carried out to find the most effective means of providing cathodic protection. It has been found that magnesium is effective in setting up a current from itself to lead, copper and steel. For that reason the magnesium bars will be used here at the Fairless Works. All copper and lead placed underground will be coated with a

neoprene jacket. From time to time it will be necessary to replace the magnesium bars as they are eaten by the currents they set up. Before magnesium was decided upon, engineers of U. S. Steel made extensive tests of this metal in samples of water and soil from the site of the plant.

New Process for Titanium

➤ A NEW PROCESS for the extraction of titanium and zirconium from their ores more economically and in larger quantity than heretofore is claimed by Arthur J. Kerbecek, Jr., a Ph.D. candidate at Columbia University.

Prof. Herbert H. Kellogg of Columbia's Engineering School plans to present the achievement to the government in hope that it will make possible the use of titanium on a large scale in ships, weapons, jet airplanes and other war material.

The process is an electrolytic method for reducing the chloride, which is prepared from the oxide of the ore. Details are kept secret.

Kerbecek worked for three years on the process following suggestions from Dr. Colin G. Fink, inventor of the commercial method of chromium plating.

Titanium is the ninth most abundant element in the earth's crust, and it is light in weight, with high melting point and high resistance to corrosion.

The new process is expected to be useful also for the extraction of zirconium, a metal somewhat similar to titanium, that the Atomic Energy Commission desires in large quantity.

Heat-Absorbing Plate Glass

➤NEW HEAT-ABSORBING plate glass for windows, when used with one light of the conventional quarter-inch thick type, will exclude 61 per cent of the total sun radiation but transmit 71 per cent of average daylight. A combination of two lights with a sealed air-space between will exclude 78 per cent of the solar radiation and transmit 62 per cent of the light.

This new glass is manufactured by the Libbey-Owens-Ford Glass Company. It is particularly suitable for use in large insulating windows in air-conditioned factories, offices and homes. Its use permits smaller air-conditioning units and saves initial cost and operating expense.

The glass is exceptionally well designed for use in shops where abundant daylight is required but where eyes must be protected from glare for close work. Another application is in show windows where baked goods, candy and flowers are on display, to protect the merchandise from heat.

Heat-absorbing glass of various types is already in use but this new low-expansion type of glass is claimed as superior in its ratio of daylight transmission to solar heat reduction. This gives it optical advantages and improved performance in its dual function of glare reduction and temperature reduction.

Layers of glass cloth and glass wool are used in a protective suit for fighting extremely hot gasoline fires.

Turn to Iron Sulfide to Relieve Sulfur Shortage

Sulfur Resources Combed

➤ WORLD shortages of sulfur, and the industrial sulfuric acid made from it, may be relieved by utilizing Minnesota's great deposits of iron sulfide to obtain both sulfur and iron.

This is the hope of government scientists working in the laboratories of the U. S. Bureau of Mines at the University of Minnesota. The objective is to find practical means to recover both sulfur and iron from the iron sulfide deposits. Also under study is the problem of recovering manganese from low-grade manganese-bearing iron ore which is plentiful in the state.

Sulfur is on the government's critical materials list. The sulfuric acid made from it is an essential in many industrial processes. Most important is in making the superphosphate fertilizers on which American agriculture depends in large measure. But it is also widely used in making insecticides, paper pulp, explosives, dyes and coal tar, rubber, paint and varnishes. The world demand for sulfur can no longer be met by the natural sulfur mined in Louisiana, Texas and other parts of the world.

Nitric Acid a Substitute

➤ SOME relief from the present worldwide shortage of sulfur and sulfuric acid is promised with processes for making fertilizer with plentiful nitric acid.

The shortage of sulfur and sulfuric acid is currently the most acute one facing the chemical industry, chemically-based industries, and agriculture, the Soil Science Society was told at a recent meeting at State College, Pa. by Dr. Eugene D. Crittenden of Allied Chemical and Dye Corporation.

The Tennessee Valley Authority, he said, has done extensive pilot plant work on nitro-phosphate processes and on agronomic testing of the product. The most successful processes studied by this organization were those using nitric acid in admixture with either sulfuric or phosphoric acid. The product, after granulation and drying, is reported to have good storage properties and to give excellent results in crop-growing tests.

Substitution of nitric for sulfuric acid will require alterations in the whole technology of superphosphate manufacture, he stated. The alterations include equipment, processing methods, and product finishing steps. More extensive equipment is needed for finishing nitro-phosphate products than is ordinarily employed in producing ammoniated superphosphates or ammoniated complete fertilizers.

Newly Discovered Sulfur

➤ THE NEWLY discovered sulphur deposit in Louisiana, if of sufficient extent, will play an important part in the economy of America and also that of the free world.

The United States produces an-

nually nearly 5,000,000 tons of sulfur, exports much, but utilizes some 3,500,000 tons in this country.

About three-fourths of the sulfur consumed in America is converted into sulfuric acid before entering its ultimate use. By far the largest use of this acid is in making superphosphate fertilizers, an essential in producing enough food to maintain the American people at present standards. American consumption of sulfuric acid in making fertilizer is approaching 4,000,000 tons a year.

The second largest use of this acid is in the manufacture of other chemicals including explosives needed in war and in industrial activities. Some 2,000,000 tons are used each year for this purpose. Petroleum refining is the third largest consumer, using over 1,000,000 tons a year. A very important use of sulfuric acid is in the iron and steel industry. Without it, essential steels for national defense and civilian uses would be produced with difficulty.

Manganese From Low-grade Ore

➤ AMERICA'S ability to produce manganese commercially from its own plentiful low-grade ore is a step forward with the development of a process which uses nitric acid as a reduction agent, with most of the acid recovered for reuse.

While manganese has many uses, the most important one is in steel making. Nothing else has been found that can take its p'ace. For every ton of steel produced, 13 pounds of manganese are used. About 90% of the manganese ore now used in this country is imported from countries where high-grade ore is found. Russia was once the principal source but in these Iron Curtain days most of the ore is coming from India and Africa. American consumption in the steel industry is about 1,500,000 tons a year of ore which averages 48% manganese.

The new process is called the Nossen Nitric Acid Cycle because developed by E. S. Nossen Laboratories, Inc., of Paterson, N. J. It is described by Ernest S. Nossen in a recent issue of *Industrial and Engineering Chemistry*. Several methods have been developed to reduce America's manganese ore, which is mostly all low-grade, but most of them are too costly for commercial applications.

As described by Mr. Nossen, the process is applicable to carbonate and oxide ores and to several types of silicate ores. It permits the separation of manganese from iron, silica and other impurities, and produces a 60% concentration of manganese.

The process starts with grinding the ore to a fine size, then treating it in a reducing atmosphere. The greater part of the manganese goes to manganous oxide, and the iron oxide is reduced to ferrosoferric oxide. Nitric acid is used to leach out the manganese which becomes manganese nitrate. In the presence of air at a temperature of 200 degrees Centigrade, the manganese nitrate becomes manganese oxide and nitric acid.

Recovery of Chemicals Key to Economy Gasoline

Oil Shale and Coal for Future Gas

➤ SYNTHETIC gasoline from coal can be made economically, in spite of the high cost in present experimental work, provided valuable chemicals obtainable in the manufacturing process are recovered and made marketable.

This is the opinion of Dr. G. F. D'Alelio of Koppers Company, Inc., who has revealed that his company is building a pilot plant at its new Verona, Pa., Research Center to make gasoline from coal by the hydrogenation process. Gasoline of aviation rating can be made by this system, he stated, but a long list of aromatic chemicals such as benzene, phenols and cresols may be obtained in the process.

While plants to make gasoline from coal are costly to build and gasoline could not presently be produced in them at prices in competition with petroleum gasoline, research is finding ways to produce an increasing number of valuable chemicals in such processes, he said. These processes can be regulated to produce more chemicals and less gasoline. It is here that upgrading of products may result in a "coal-to-gasoline" plant becoming economically feasible much sooner than many think.

These chemicals are the building blocks for thousands of other materials, and Koppers believes that when such plants are built, new chemical fields will be opened, just as perfection of the chemical-recovery coke oven nearly 50 years ago created chemical, tar processing, wood preserving and other industries which are strong and still growing today.

Gasification and hydrogenation are the two best-known methods for making gasoline from coal. From direct gasification, the process in use in the demonstration plant of the U. S. Bureau of Mines in Missouri, a synthetic gas containing primarily hydrogen and carbon monoxide is produced. This, in turn, can be the base for synthetic gasoline and many aliphatic chemicals such as alcohols, aldehydes, ketones and the fatty acids which also have wide use in industry.

Interconnect Gas Pipelines

➤ A SEMI-NATIONAL "hook-up" of pipelines bringing natural gas from fields in the southwest to northern and eastern areas was suggested recently by Frederic O. Hess, a director of the Gas Appliance Manufacturers Association.

Interconnecting pipelines between the now separated main lines would be a public aid, particularly when seasonal or other emergency conditions place extra stress on the system.

We know how effectively such interconnecting and looping systems protect the electric industry against power failure, peak demands, unbalanced load factors and excessive distribution costs, he stated. Similar benefits would result if the many natural gas pipelines supplying gas to the area

from the Mississippi to the Atlantic coast were interconnected. Particularly, he suggested benefits that would follow an interconnection from Kansas City eastward to New England. This would make Texas panhandle gas available in times of need to the eastern area.

Another step advocated by Mr. Hess to assure the eastern states of a plentiful supply of natural gas during winter months is a search for additional natural gas in the Appalachian region. It was gas from this eastern area that was first used in America for heating and lighting. Untapped supplies could be located, he seems to feel.

A research and development program sponsored by the gas industry is also recommended by Mr. Hess. The program would be concerned with the integration of the distribution facilities and expansion of its service to the public. There are some 260,000 miles of natural gas pipelines in the United States. Gas now is used in the homes of 28,000,000 Americans and in more than 25,000 different industrial processes.

Future Energy Sources

▶ OIL SHALE and coal will furnish the power of the future, geologists of the nation agree.

The American Geological Institute in a survey finds that these experts are not confident that atomic energy will find substantial industrial use even by the year 2000. Water power and solar energy will also play a role minor to processed oil shale and coal.

By 1957 direct production of natural petroleum will be past its peak, the geologists agree, and oil imports will be insufficient to meet America's needs. The large oil shale deposits of the Colorado plateau and the low grade coals of the Midwest and plains area will supplement the declining supplies of natural petroleum. Powdered coal will replace industrial fuel oil. Coal production should double within 25 to 30 years, with most of this increase used as liquids or gases rather than in solid form.

New light-weight metals, such as titanium, will find extensive use in the future, the geologists believe, because methods will be developed to extract them more easily from the earth.

Twice the present supply of 15,000 geologists will be needed in the near future to explore for new mineral supplies by geological and geophysical methods, aid construction industries and work on agricultural problems, the Institute predicts.

Rhenium is a little-known metal, now produced in a very small quantity in America, that some day may play an important part in high-temperature alloys.

American distillers and brewers of alcoholic beverages use each year approximately 30% of the barley grown, 24% of the rye, 10% of the rice, and from 1% to 2% of the corn.

Much nutmeg and mace for the United States comes from Grenada, a British-owned island in the Windward group, West Indies.

Body Needs B Vitamin To Make Cortisone

Good Diet Presents Many Facets

➤ DISCOVERY that the B vitamin known as pantothenic acid is needed by the body to manufacture cortisone, famous arthritis medicine, was announced by Dr. George R. Cowgill of Yale University at the International Conference on Vitamins at Havana, Cuba.

The discovery was made in experiments by himself and Robert W. Winters, Robert B. Schultz and Dr. Willard A. Krehl.

It might suggest that arthritis sufferers would be helped by doses of the vitamin, but there is no evidence that this would be the case.

Depriving rats of patothenic acid causes hemorrhage and other damage to the adrenal glands, other scientists had previously discovered. The cause of this had been a matter of debate and it was to settle the matter, if possible, that the Yale scientists started their research.

The damage to adrenal glands of rats deprived of the vitamin is more severe, they found, when the animals are given ACTH. This is the pituitary hormone that stimulates adrenal glands to produce cortisone. The adrenal damage caused by vitamin lack can be prevented by cortisone, Dr. Cowgill reported.

In tests of the rat's utilization of starches and sugars during pantothenic acid deficiency, the Yale scientists found more evidence that the vitamin deficiency caused failure of the adrenal glands to produce cortisone.

This all points to the vitamin as essential for fully functioning adrenal glands and for production by them of cortisone.

Now the Yale scientists are trying to set up experiments to see how rats deprived of the pantothenic acid vitamin will react to stress of various kinds. The adrenal glands react to stress in various ways. How they react in a vitamin-deficient animal is expected to give more information that may be useful ultimately in treating human patients.

Good Diet Worsens Disease

➤ A HINT that a super-good diet for making children grow big and strong may boomerang and make worse some of the chronic diseases of middle and old age appears in a report from the U. S. Bureau of Human Nutrition and Home Economics.

Combinations of food that seem to provide adequately for growth may tend to accentuate certain chronic ailments commonly associated with age, is the official wording of the report summing up research by three of the Bureau's scientists.

The research was made on rats, classic animals for nutrition studies. The rats ate rations cooked as for

human consumption. The diets included such food as round steak and pork loin, carrots, potatoes, kale, eggs, navy beans, milk, corn meal, rice, enriched bread and hydrogenated fat.

In general, the scientists report, the diets that promoted the largest early weight gains and the heaviest adult animals also tended to promote fatness, more body sores at an earlier age and more bronchiectasis. This lung disease is considered like hardening of the arteries in man, in that both are chronic, progressive diseases which limit the life span. Body sores are usually considered a sign of senility in rats.

The rat's response to diet may not be identical with that of man, the scientists warn. A good diet for making children grow may not have any repercussions later in life. But the research does point up the fact that the over-all nourishing value of human type diets for human beings cannot be judged by the effects of the diets on rats without careful evaluation of the findings.

By keeping this in mind, however, it is believed that by feeding selected diets to rats over their entire lifespan through several successive generations, much can be learned about the influence of entire diet patterns on growth, reproduction and aging.

The scientists whose work is summarized in the annual report of the Bureau are Drs. Elizabeth Crofts Callison, Elsa Orent-Keiles and Rachel Uhvits Makower.

Undernourished Children

➤ Vitamin B 12, newest of the vitamins needed by humans, makes mice, rats, chicks, hogs and some kinds of bacteria grow faster. But it does not make undernourished children eating a poor diet grow.

This failure of the vitamin to overcome the effects of a continued poor diet was reported by Dr. Tom Spies of Hillman Hospital, Birmingham, Ala., and Northwestern University, Chiago, at the International Vitamin Conference.

The report was based on tests made by Dr. Spies and associates, Dr. Samuel Dreizen, dentist, Miss Catherine Currie and Miss Clara C. Buehl. The vitamin was given to nine children over a period of 16 months. The children were chronically undernourished. This was reflected in a poor growth rate. They came from poor families living on limited amounts of food. Their basic diet consisted of corn bread, biscuits, dried beans, turnip, mustard or collard greens, fat pork, corn or cane sugar syrup and home grown vegetables in season. It was deficient in all of the essential nourishing items for which standards have been accepted.

During the trial of the vitamin, no effort was made by the scientists to change the diet of these children. One child was able to have more vegetables after the family raised their own garden. Two others got fresh milk and butter after the family bought a milk cow.

Some of the children from time to time said their appetite improved and most showed a slight increase in red blood cells and hemoglobin in their blood. But only one child out of the nine showed a slight increase in his rate of growth and this was one of the children whose family had bought

a cow during the period of the vitamin trial.

These trials of the vitamin do not, of course, mean that there is any failure of the vitamin's ability to remedy pernicious anemia and certain other anemias. Nor do they mean that the vitamin will not help children grow if they are getting a good diet, as was the case in earlier reports of its growth-stimulating effect in children.

Vegetarian Diet Adequate

➤ Both the vegetarian type and the carnivorous type of diet can adequately feed mankind, Dr. Robert S. Harris of Massachusetts Institute of Technology, Cambridge, Mass., declared at the International Conference in Havana.

The realization of this fact by those who struggle with the food problems of the world is of terrible importance, he stressed.

There is not enough land in the world to feed all mankind on a meat and milk type of diet. But people can be well nourished on a diet that is rich in cereals, such as wheat, corn and rice, and in legumes, or beans, and other vegetables and fruits.

Dr. Harris urged a realistic approach to the world food problem by finding the foods native to a region that are nourishing and building diets around them. He fears that considerable harm has been done by shipping an excellent food, such as milk, into undeveloped areas for use in school lunch programs and telling children milk and other foods of animal origin are necessary for their nourishment.

There is no indispensable food and it is now obvious that there are many ways to compound a good diet, Dr. Harris stated.

It does not matter, whether the calcium comes from milk or tortilla, whether the iron comes from meat or tampala, whether the niacin comes from liver or peanuts, whether the tryptophane comes from the eggs or soybeans, or whether the calories come from wheat or rice, so long as these nutrients are available.

Excellent evidence on this point is offered by the study of the diet of the Otomis living in the Mesquital Valley desert of Mexico. The diet intake of families in four villages was studied and the nutrient content of these diets was calculated from our food analysis data. Though they ate mainly maize, beans, weeds, pulque, and minute quantities of milk, meat and eggs, their diets were quite satisfactory, and the people showed little clinical evidence of malnutrition.

There are oases in the Arabian desert so malarious that the wandering Bedouins visit them only long enough to gather the date harvest.

Cellulose acetate plastics and nitrocellulose plastics are similar in some respects but the nitrocellulose is highly flammable while the other burns slowly.

Flourescent mercury lamps, recently developed, contain a new phosphor and while still retaining the high efficiency of mercury vapor, produce a more acceptable color.

For the Home Lab

Benzyl Alcohol and its Derivatives

by BURTON L. HAWK

➤ WE ARE all familiar with ordinary alcohol and wood alcohol, but how much do we know about the other alcohols? There are many other alcohols having interesting and useful properties with which we should become better acquainted.

Benzyl alcohol, $C_6H_5CH_2OH$, is found free in Peru balsam and in combination in Tolu balsam, storax and cherry laurel. It is a clear, colorless liquid with a faint aromatic odor and a sharp burning taste. It differs from ordinary alcohol in that it is not very soluble in water.

Oxidation

Ethyl alcohol is oxidized to acetaldehyde and acetic acid. Methyl alcohol is oxidized to formaldehyde and formic acid. And, in a similar manner, benzyl alcohol is oxidized to benzaldehyde and benzoic acid.

Mix together 1 cc. of concentrated nitric acid with 4 cc. of water and add 5 drops of benzyl alcohol. Heat gently for a few minutes. You will soon be able to recognize the familiar bitter-almond odor of benzaldehyde. To carry the oxidation further, continue to boil the mixture until the odor of benzaldehyde disappears. Be careful in heating this mixture, as it tends to boil in spurts and is liable to boil out of the tube. Always hold the test tube *away* from your face. When the almond odor can no longer be detected, discontinue heating and immerse the tube in a container of cold water. Benzoic acid will crystallize out.

Reaction With HCl

Mix 1 cc. of benzyl alcohol with 2 cc. of concentrated hydrochloric acid in a test tube and heat gently. Note the odor *cautiously*. This is benzyl chloride. It is a potent *lachrymator*, which means its vapors induce irritation in the nostrils, pain in the eyes, and a heavy flow of tears. This property is characteristic of many aromatic compounds containing a halogen in the side chain. They find use in chemical warfare agents and in "tear gas."

Reaction With H_2SO_4

Now when we treat ordinary alcohol with sulfuric acid we obtain an alkene (ethylene). Not so with benzyl alcohol. The action between sulfuric acid and benzyl alcohol forms a resin. Place 1 cc. of benzyl alcohol in a large test tube and *carefully* add an equal quantity of concentrated sulfuric acid. Warm gently. Again, use care as the liquid may tend to spurt out of the tube. Do not heat strongly. Note that the solution gradually solidifies. Allow it to stand and it will harden into a plastic-like resin.

Synthetic Perfumes

Benzyl alcohol and its esters are used in the manufacture of synthetic perfumes.

Benzyl acetate is present in the gardenia. You can prepare it by mixing

together 1 cc. each of benzyl alcohol and glacial acetic acid. Add just one drop of sulfuric acid and warm the mixture for a few minutes. Remove from the flame and smell cautiously. Note the pear-like odor. You will be able to detect the odor better if you allow the mixture to cool a bit.

Benzyl benzoate is present in Peru and Tolu balsams. It has a pleasant, although rather faint, odor. Add a small quantity of benzoic acid crystals to 1 cc. of benzyl alcohol in a test tube followed by one drop of sulfuric acid. Again, heat gently and note the odor.

Benzyl salicylate has a somewhat "minty" odor. It is prepared as outlined above using salicylic acid in place of benzoic acid.

Just to try something different, mix together the benzyl benzoate and salicylate just prepared and warm for a short time. Allow to cool. The resultant odor is somewhat difficult to describe and we shall let you be the judge as to whether it is good or bad.

By experimenting in this manner you can obtain some unusual fragrances — some pleasant and some otherwise. But whenever you try something new or unfamiliar to you, remember to exercise caution. Use only very small quantities and never sniff at a mixture that is boiling or reacting.

Benzyl alcohol also finds use in medicine as an antiseptic and in industry as a solvent for cellulose acetate.

It can be prepared by reducing benzaldehyde with sodium amalgam and water, by hydrolyzing benzyl chloride or by the action of potassium hydroxide on benzaldehyde. This latter method is known as the Cannizzaro reaction (see CHEMISTRY March, 1948).

Nitrogen From Air by New Process

➤ NITROGEN grabbed from the air by a new, thermal process will benefit American agriculture and will help to build up our supply of the element for manufacturing explosives and propellants.

A pilot plant for the process, developed in Wisconsin, is now producing a ton of 60 per cent nitric acid per day in San Jose, California, and another plant will be constructed at Sunflower, Kansas. The method uses only air, water and energy for raw materials.

The air is milked of its nitrogen in a high-temperature, specially-constructed furnace to make nitrogen oxides, then the minute amounts of nitrogen oxide formed are recovered and concentrated. Water added to nitrogen dioxide will give nitric acid, vitally needed in the manufacture of explosives and propellants.

The thermal process was developed with the co-operation of the Wisconsin Alumni Research Foundation. Finding a material that would stand up under the furnace temperatures was a major problem in developing the process but a pure magnesium oxide was made to fill the bill.

Meteorologists Study Effect Of Rain-Inducing Chemical

Silver Iodide and the Weather

➤ NEW EXPERIMENTS have added to the controversy over whether rain can be artificially induced over wide areas by seeding with particles of silver iodide. Silver iodide is now generally used in the $3,000,000-a-year rainmaking industry.

The experiments, conducted by one of the original rainmakers, Dr. Bernard Vonnegut and by Raymond Neubauer both of the General Electric Research Laboratories almost directly contradict earlier tests which claimed to show that after 20 minutes exposure to sunlight, silver iodide particles lost their effectiveness as rain "triggers."

Dr. Vonnegut and Mr. Neubauer said, in a report to the American Meteorological Society, that recent experiments showed that from 40% to 100% of the silver iodide remained active after one hour of exposure to ultraviolet light.

Their recent results also do not jibe with the results from another set of experiments in which Dr. Vonnegut took part in New Mexico. At that time, Dr. Vonnegut and his associates in the experiment found that the number of nuclei in a given sample of silver iodide smoke was reduced by a factor of from ten to 100 after an hour's exposure to sunlight or comparable radiation.

The experiments which showed that 20 minutes was long enough to kill the effectiveness of silver iodide were conducted by Edward C. Y. Inn, of the Air Force Laboratories at Cambridge, Mass. He observed that light changed the shape of silver iodide particles. They were first used in attempts to make rain because they are shaped like ice crystals. If their shape is changed, they cannot form ice.

Because of their original shape silver iodide crystals are being used in the rainmaking operations over most of the western states.

Dr. Vonnegut and Mr. Neubauer carried out a series of 12 experiments in which silver iodide smoke was subjected to ultraviolet light. Samples of this smoke were then introduced into a supercooled cloud.

The two scientists do not know, they say, the reasons for the different results from the three sets of experiments. However, they think the efficiency of silver iodide may be influenced by impurities, either in the smoke or in the atmosphere.

Seeding May Decrease Rain

➤ TRYING to make it rain out of miniature thunder clouds by seeding them with silver iodide may actually decrease the amount of rain which would have fallen naturally over an area. This is the opinion of Dr. E. J. Workman, president of the New Mexico Institute of Mining and Technology, presented at a session of the American Meteorological Society devoted to artificial rainmaking.

In fact, said Dr. Workman, if silver iodide crystals are efficient substitutes for natural water-droplet-forming nuclei in the air, it would appear reasonable to undertake a rain reduction program in some areas by extensive pollution of the atmosphere with these crystals.

Seeding immature clouds may dissipate some of the energy necessary within the general area for the creation of thunderstorms and thus actually reduce the amount of rain which otherwise would have fallen naturally.

This might have an effect on the weather over a very large area. Dr. Workman pointed to the theory held by Nobel Prize Winner Dr. Irving Langmuir that "rainmaking" with silver iodide in New Mexico had an effect on the weather over a large area of the United States.

Dr. Workman said that the local effect which he found of dissipating energy by seeding with silver iodide crystals might be responsible for the widespread effect rather than any local increase in rain over New Mexico.

Originally an enthusiast over the possibilities of increasing rainfall by cloud seeding, Dr. Workman admitted that "the enthusiasm with which we started about four years ago has not been sustained. Our simple field experiments designed to test elements of current rain-increasing practice have been inconclusive for the most part, and, moreover, our accumulated laboratory observations give us cause to doubt some of the basic assumptions inherent in the youthful rainmaking technology."

Dr. Langmuir, speaking at the same session, reported on a statistical study which, he said, showed that periodic seeding with silver iodide in New Mexico caused periodic effects in rainfall over a wide area of the United States.

He asserted that the agreement which he found between most of the rainfall and seeding phases "gives conclusive proof that the periodicity was actually caused by silver iodide seeding."

Dr. Langmuir disagreed with statistician Glenn Brier of the U. S. Weather Bureau. Mr. Brier stated that based on usual scientific standards "it appears that the hypothesis that silver iodide seeding affected the larger scale features of the weather or circulation has not been demonstrated."

Discussion of whether or not seeding with silver iodide crystals on a periodic basis actually causes large-scale changes in the weather has been going on for more than two years. Many meteorologists and physicists believe that the controversy will never be settled.

A decade ago practically all tin-plated steel, for cans and other purposes, was coated by dipping; now over 60% of the production is plated by electrolysis.

Among synthetic rubbers now produced in America are Buna-S, Buna-N, thiokol, neoprene, butyl and silicone; each has special properties and therefore special uses.

Chemicals Play Major Part In Every Agricultural Operation

Agricultural Chemicals

Extracts from an address by Robert M. Salter, Chief, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture at the 18th semi-annual meeting of the National Agricultural Chemicals Association at Miami Beach, Florida.

➤ TODAY, chemicals are being used as a supplemental weed control tool in the production of such field crops as corn, wheat, oats, barley, rice, flax, sorghums, pastures, meadows, cotton, peanuts, sugar beets, sugarcane, and others. Satisfactory chemical weed control methods have been worked out for such horticultural, ornamental, and vegetable crops as asparagus, carrots, daffodils, gladioli, lima beans, onions, parsnips, peas, potatoes, snap beans, sweet corn, strawberries, tree fruits, and many others. Our weed specialists estimate that last year farmers applied herbicides to more than *30 million* acres of cropland in the United States.

Also, herbicides are being used more and more on non-cropped land. The use of chemicals for controlling brush and stump sprouts along railroad right-of-ways, power lines, communication transmission lines, highways, and canal ditches is rapidly replacing hand cutting in all parts of the country where woody plants are a problem. One commercial company alone last year used about 600 tons of ammonium sulfamate for controlling brush. Herbicides are being used annually on several hundred thousand miles of highway road banks and farm fence rows.

This amazing development stems directly back to the basic discovery of less than ten years ago that certain chemicals could be used to control the growth of plants. I consider the discovery and development of these chemicals as one of the major accomplishments of agricultural science during the past decade.

Discovery of 2,4-D

The discovery of 2,4-D stimulated intensive interest in the use of a wide variety of chemicals for weed control. During the past five years herbicidal investigations have mushroomed all over the country. Few people realize the extent to which chemicals are being studied for weed control purposes. Major projects are underway in every State, by both public agencies and commercial firms. A bibliography of weed investigations issued this winter by our Weed Division lists nearly 2,500 different papers on weed control that were published in various journals during 1950. About 90 per cent of them dealt with chemical weed control in one phase or another. Incidentally, copies of the weed bibliography are available at no cost to industrial research organizations.

While 2,4-D is the most widely used herbicide, practical uses are now

being found for many other chemicals, such as 2,4-5-T, IPC, TCA, ammonium sulfamate, cyanamid, chlorates, arsenicals, boron compounds, dinitro compounds, herbicidal oils, and others. Initial investigations with these chemicals determined their effects on various species of weeds. The current trend is to concentrate study on weed control in specific crops or under specific problem conditions. Studies are underway on a'most every crop grown in American agriculture. At the same time basic study of physiological effects and responses of plants from applications of chemicals is continuing.

Pre-emergence Sprays

One of the most significant current developments is centered around the use of chemicals as pre-emergence sprays. The principle involved here is one of killing the weed seedling during the process of germination. The chemical is applied on the surface of the soil after the crop has been planted but before seedlings come up. Seedlings of some crops can grow through treated soil without damage whi'e the seedlings of most broad-leaved weeds and annual grasses are killed as they germinate in the top ¼ to ½ inch of soil. This gives effective weed control without cultivation for a period of several weeks after planting.

Promising results from pre-emergence treatments have been found with sugar beets, cotton, peanuts, soybeans, potatoes, corn under certain conditions, asparagus, gladioli, and other field and horticultural crops. The sugar beet industry in the Midwest is enthusiastic about using TCA as a pre-emergence weed control measure to reduce the need for hand weeding in sugar-beet fields. Many grower contracts this year provide for pre-emergence weed control, with beet companies footing part of the cost of treatment. They expect this measure to eliminate the need for many hand laborers in sugar-beet fields—a highly important development at this time when farm labor is scarce.

Some cotton growers already are turning to these chemicals, as a means of off-setting the shortage of labor for hand hoeing. If they get good results this year, many additional growers will undoubtedly adopt the practice in order to expand cotton production despite labor limitations.

Cotton production in the United States still requires an average of about 100 man-hours of labor per acre. When we realize that much of this labor is needed for hand hoeing, the enormous potentials from chemical weed control in cotton become readily apparent. There is no doubt about it. Pre-emergence herbicides have a big future.

Chemical treatments have also been perfected for solving some difficult weed problems in irrigated areas of the West. There, the extent of crop production is determined largely by the supply of irrigation water. Pest plants in and along irrigation channels can draw off large quantities of water before it reaches the crop land to be irrigated.

Recent research on this problem has yielded effective chemical measures for controlling many of the pest plants. Growth controlling chemicals can be used to kill willows, cattails, and other weed vegetation growing along the banks of irrigation ditches

and canals. Aromatic solvents, injected into the water channel, will control submerged weeds for only one-tenth the cost of mechanical clearing.

The discovery that plant hormone type chemicals will kill some kinds of brush at relatively low cost offers new means for expanding beef production on range land in the Southwest. More than 100 million acres of formerly productive grasslands in that area have been invaded by mesquite and other noxious brush plants during the past half century. The brush has greatly reduced the carrying capacity and the productiveness of the native range. Scientists who are in close contact with the problem have estimated that removal of brush from this range land would provide potentially an additional 500 million pounds of beef annually.

Many other developments in chemical weed control also promise to help farmers save labor and increase production. The point I want to stress is that the use of herbicides has now become firmly established in agriculture. Chemical weed control *is here to stay*. It is important, however, for your industry to recognize that herbicides are basically a *supplemental* weed-control tool. Chemicals will not replace efficient cultural methods of weed control, but they promise to become an ever increasing adjunct thereto, especially as uses for chemicals are further developed to meet specific problem conditions.

Equally dramatic progress is being made in research with chemicals for controlling fungus diseases of plants. The most important advance here has been the discovery that an array of complex organic materials such as dithio carbamates, phenyl mercury compounds, dichloro naphthoquinone, gloxyalidines, dinitro compounds, and phthalimide derivatives, are effective fungicides. These materials represent the end-product of a decade of close teamwork between the chemical industry and plant pathologists.

More Specific Action

Generally, these compounds are more specific in their action than the older fungicides, and they often give more effective disease control. Their use reduces demands for such strategic materials as copper and sulfur. Recent estimates indicate that more than ten million pounds of organic fungicides were devoted to agricultural uses in 1950. Research is now being intensified to develop even wider uses for them.

Significant progress has been made in controlling fungus diseases of tree fruits. Copper and sulfur are effective fungicides, but they sometimes cause considerable injury to fruit and leaves. Organic chemicals are proving to be equally effective for disease control with less risk of plant injury.

Spraying and dusting for disease control has previously been considered impractical with field crops because the cost of application is high in comparison with the moderate yield increases that can be expected. It is interesting to note that investigations for the field treatment of wheat rust are now being initiated in an effort to find a fungicidal protection against the new race of wheat stem rust that broke out last year.

In the field of fungicides generally, we can expect the trend toward or-

ganic compounds to continue. A large number of new organic materials are now being tested, and there is no doubt that more and more tailor-made compounds will be found to solve specific disease problems.

Important progress is also being made with soil fumigants for controlling nematodes, insects, and other soil pests. This is a relatively new field for chemicals in agriculture. The recent discovery of less expensive soil fumigants is now making nematode and wire-worm control possible under field conditions. To be able to protect the underground parts of plants against soil pests, represents an enormous forward step.

Nematode Control

Nematodes are microscopic worms that live mainly on plant roots, and do considerable damage to crops in some areas. Nematode damage is most severe in the warmer regions of the United States where the long growing season is favorable for rapid multiplication. The root knot nematode affects tobacco, cotton, peanuts, corn, sweet potatoes, vegetables, and other crops. The golden nematode of potatoes is a serious menace to potato production on Long Island. And many of the country's sugar-beet growing regions are infested with the sugar-beet nematode.

Experimental and commercial applications of soil fumigants in nematode infested soils have resulted in substantial yield increases with variety of crops in many locations. Recent tests have shown that nematodes are an important factor in crop production over a much larger area than we have suspected. Experiments with fumigants in many areas where we have no previous knowledge of nematode infestations have produced yield increases of more than 20 per cent.

The primary limiting factor in the use of soil fumigants at this time is the high cost of applications. Complete extermination is seldom possible under field conditions. In many instances, treatments are effective for only one or two seasons.

Chloropicrin and methyl bromide are so expensive that their use is limited primarily to greenhouses, nurseries, and seedbeds. Field fumigation has been made possible by the recent discovery that less expensive chemicals, such as dichloropropene and ethylene dibromide, are effective fumigants and that strip, row, site, or spot fumigations often give adequate control.

Even these cheaper chemical treatments cost $35 to $40 per acre. Therefore, their use is limited to high value crops such as tobacco, sugar beets, and vegetables. About four million acres of crop land in the United States may be classed as producing crops of sufficient value to pay reasonable returns for soil fumigation. Experimental evidence indicates that soil fumigation would be profitable on at least three-quarters of this land. The best available estimates indicate that enough fumigant is now being manufactured to fumigate only about 150,000 acres —one-twentieth of the potential area. And a substantial quantity of the available fumigant will probably be used for pineapple production in Hawaii.

The use of chemicals in preserving crops and for improving crop quality is another field that has received considerable scientific study during recent

years. Extensive use is being made of chemicals to protect fresh fruits and vegetables from disease damage during transit and storage. Chemicals such as borax, sodium ortho-phenylphenate, and chlorine compounds are used in washing most citrus fruit to prevent decay. Sodium chloro phenylphenate is used for controlling decay in apples and pears from the Northwest. Sulfur dioxide is used in fumigating grapes to protect them against rot during transit and storage. Copper impregnated wrappers are used for controlling grey mold rot on pears. Dry ice is used to build up concentrations of carbon dioxide in refrigerator cars to prevent decay and ripening of sweet cherries and strawberries. Waxes that are mixtures of paraffin and carnauba are used to retard water losses from potatoes, cucumbers, rutabagas and various other vegetables.

As a result of chemical treatments marketing losses are being reduced, nutritional values preserved, keeping quality improved, and the marketing season extended for many fresh fruits and vegetables. Furthermore, thousands of new chemicals are being tested in our current transportation and storage studies. For example, we have tested nearly 2,000 organic compounds in our search for better measures of controlling citrus decay. About 50 of them have promising antiseptic qualities.

Chemicals have long been used as wood preservatives, but this field, too, has received more experimental study during recent years. The increased demand for lumber has resulted in the use of more of the decay susceptible and water absorptive sapwood. Therefore, the need for preservative treatment has increased.

Current studies indicate that decay of pulpwood may be effectively delayed by small amounts of fluorides applied as spray in pulpwood piles. The fluorides apparently stimulate a relatively harmless mold that has an antibiotic effect on the decay organisms. Studies in the pulp industry are being continued, and possible applications of these effects to other fields are being explored. Dips of sodium pentachlorophenate and ethyl mercuric phosphate developed for use against stain fungi also appear effective against decay in green lumber during storage and transit.

A wide variety of effective treatments has been worked out for horticultural crops. Commercial plant propagators are using plant growth regulators to induce rooting on hard-to-root cuttings. Fruit growers are using them to prevent apples and pears from dropping to the ground before they are ready to pick. Pineapple growers are using them to stagger their harvest periods.

Prevent Sprouting

Other chemical treatments can be used to prevent potatoes and onions from sprouting in storage, to hasten the ripening of certain fruits, and to reduce hand labor in the production of some horticultural crops. Chemical thinning of apples, for example, is becoming a commercial practice in the Pacific Northwest. Last year about 20,000 acres of apple orchards were thinned with spray applications of dinitro at blossom time. Our experimental studies show that chemical apple thinning gives a 15 per cent increase in yield for only a fraction of the cost of hand thinning.

Important progress has been made in the use of chemicals for defoliating crops, especially cotton. Several different chemicals have been found to be effective in getting leaves to drop from cotton plants before picking time, thus helping to prevent boll rots, retarding deterioration of fiber and seed, expediting hand picking, and increasing the efficiency of mechanical picking. Last year, defoliating chemicals were applied to more than 1½ million acres of cotton—about 8 per cent of the crop.

Cotton Defoliant Problems

Still, there are many problems with cotton defoliation yet to be solved. So far, we don't have completely satisfactory materials for all arid and semi-arid conditions. Calcium cyanamide does a good job in humid areas where dew is common. None of the defoliants so far discovered, however, are fully effective in the absence of dew. The current trend is toward the development of specialty defoliants—materials that are effective during different stages of plant maturity and under a variety of weather conditions.

We can expect a considerable increase in the demand for cotton defoliants because of the man-power shortage. Cotton growers undoubtedly will use every available means for protecting their crop until they can get it harvested. The availability of chemical materials will have an important influence on the rate of expansion of cotton defoliation in the immediate future. Every defoliant so far developed is keyed to such critical materials as nitrogen, chlorine, sulfur, and phenol. Furthermore, the use of these chemicals on other crops will compete with their use on cotton. For instance, some kind of defoliating material will be needed this year on about 45,000 acres of castor beans—a new crop in American agriculture.

Interest is developing in the use of chemicals to improve quality with a wide variety of crops. Some potato growers are using cyanamide and other chemicals to kill disease-infested vines before diseases move into the tubers. Earlier ripening of tomatoes has been obtained through the use of chemical compounds to reduce leaf shade. Research men working with sugarcane are searching for a chemical solution to leaf problems in harvesting that crop.

Preliminary investigations with rice in California and Texas indicate that a pre-harvest spray of sodium monochloroacetate may be effective in lowering the moisture content of rice—thus improving crop quality, and conditioning the rice for storage while it is standing in the field.

In the Midwest last fall, applications of pentachlorophenol were tried commercially on weed infested soybean fields in an effort to knock down grassy weeds before harvesting. Reported results indicate that the treatment facilitated early harvesting, thus reducing loss of quality. Treatments of this type would appear to warrant more intensive scientific study. In fact, it appears that we have merely scratched the surface in exploring the possibilities of using pre-harvest applications of chemicals to improve crop quality.

This vast array of new chemical developments has been accompanied by important engineering advancements that make for practical farm applica-

tion. In fact, today's widespread usage of chemicals in agriculture would be impossible had engineering studies failed to keep pace.

Modern speed sprayers and boom equipment have speeded up field spraying and dusting and increased operating efficiency by reducing labor costs. Soil fumigation on a field basis would be impossible without recently devised tractor-drawn equipment to eject the chemical below the surface of the soil. We couldn't use non-selective herbicides on such crops as cotton and onions without sprayers designed to control chemical placement. Protective shields and hoods have only recently been perfected to direct a spray pattern so that weeds between rows can be covered without wetting crop plants. A four-row tractor mounted sprayer-cultivator combination machine has been perfected for use in cotton fields.

Agricultural Airplane

In Texas, aeronautical engineers have recently constructed a new type of airplane designed specifically for the application of chemicals in agriculture. How soon commercial manufacturing can begin will depend on the availability of materials necessary for construction. Here is a new opportunity for making airplane spraying and dusting more efficient, and for further extending agricultural uses for chemicals.

There are promising possibilities, too, for combining chemicals to do more than one pest control job from a single application. Farmers in southeastern states are already using soil treatments combining cyanamid and urea to control both weeds and fungus diseases in tobacco plant beds. Investigations are underway with combinations of insecticidal, fungicidal, and herbicidal materials. The development of organic nitrogen has made it possible to combine pesticides with nitrogen for certain foliage applications.

Science so far has made but a small beginning in developing chemicals as a farming tool. In last year's screening tests for plant growth regulating activity, for instance, we found more than a hundred new compounds sufficiently active to warrant further study. Thousands more are waiting to be tested, and even more are being compounded. Furthermore, research men are still finding new values in chemicals we are already using.

Exploratory studies with various new chemicals suggest a wide range of possible new agricultural uses. Fundamental studies along several new lines are just getting under way. For example, chemicals have been found that make plants hold water longer after they have been treated and harvested. These findings raise the question whether chemical means might be perfected to make plants resist drought.

Plant materials have long been used as a source of such insecticides as nicotine, rotenone, and pyrethrum. More recently, plants have been found to be a fertile source of animal hormone materials for medicinal purposes. Now, we are beginning to investigate the use of plant materials as a source of plant hormones. Initial studies have indicated considerable stimulation of plant vigor from their application. This raises the question whether plant hormones might be used for stimulating forage growth in

pastures and meadows, or for increasing yields and protein content of cereal crops.

In the current stage of development we are trying to find out how to get large enough quantities of hormone materials to conduct intensive studies. We need to learn how they will affect the growth of various species of plants, but supplies in many instances are limited to a gram or less. We are trying to identify these hormones chemically with a view toward the possibility of synthesizing them. While this is a new field that we are just beginning to investigate, it has potentialities of opening up an entire new phase for chemicals in agriculture.

Built-in Insecticides

There are other new lines of investigation, too. For instance, we have indications that it may be possible to use chemicals to modify plant-growth-form and plant-structure so as to make plants less susceptible to fungi and insect attack. In California, for instance, we have found that chemicals can be used to make the buttons stick on lemons during marketing, thus protecting the fruit against damage from fungus diseases.

Scientists in both England and the United States are very much interested in systematic insecticides. The idea is to incorporate the insecticide into the plant's growing system. While the current stage of development is still highly theoretical, this field would appear to warrant more intensive study.

There may be possibilities, too, for using new chemicals to control soil structure. One chemical company has developed a family of organic compounds that strongly promote soil aggregation, giving much the same effect as organic matter on soil structure. We are just starting laboratory study on the effect of these materials on the important classes of soils in the United States. It is still too early to know whether practical uses might be worked out.

It is impossible to forecast what new agricultural uses for chemicals may be forthcoming as a result of current and future scientific research, but there can be no doubt that chemicals will become increasingly important as a farming tool.

Claims of Manure Faddists Fallacious

➤ A "BOISTEROUS GROUP" of manure farming faddists is making "fallacious claims on the superiority of manure over mineral fertilizer."

This is the charge of J. S. Joffe of the New Jersey Agricultural Experiment Station, Rutgers University, in a paper given before the meeting of the American Association for the Advancement of Science.

Mr. Joffe went over the extensive research done in the last 100 years and concluded that there is no ground for the claim that organic fertilizers are superior to inorganic fertilizers. If anything, he said, they are inferior.

Mr. Joffe went over six points having to do with soil structure, nutrients, moisture, microbes, residual humus and accessory elements and found the claims made by manure faddists to be exaggerated.

Glass Forms Air Filter, Center of Building Panels

Glass Shatters Tradition in New Uses

➤ ALL-GLASS paper, a new product composed entirely of glass fibers with nothing added, has been developed at the National Bureau of Standards. It has several possible applications, an important one being as an air filter paper in gas masks.

It is the first all-glass paper ever made, Bureau officials state. In it commercially available fine glass fibers were used. This raw material was mixed with water and formed into continuous sheets on the semicommercial paper-making machine in use at the Bureau. A number of special problems had to be solved, however, before a paper with satisfactory strength and characteristics was obtained.

This all-glass paper seems particularly suitable for use as filters in gas masks and respirators used by fire fighters, industrial and medical workers and military personnel. In gas-mask tests in a smoke-filled room only one smoke particle in 100,000 passed through it. Another important advantage of the new product is its high resistance to the effects of heat, moisture, chemicals and micro-organisms.

The development of this paper was a joint project of the Bureau of Standards and the Naval Research Laboratory. The scientists of the Bureau responsible for it are M. J. O'Leary, J. K. Missimer, J. J. Erving, and B. W. Scribner. The Navy scientists are T. D. Callinan and R. T. Lucas.

In Concrete Wall Panel

➤ CONCRETE slabs with center layers of glass fiber, already in experimental use, are designed to lessen the cost of masonry construction and provide an insulating sandwich wall for commercial, industrial and residential use.

The slabs are factory-made. They are shipped to the job after a 12-day curing period ready for installation. They are five inches in thickness and are made in sizes from eight-by-eight feet to eighty-by-thirty feet. Edges of the standard panels are tongue and groove on all four sides to produce an interlocking joint. One side has a facing of muslin cloth, the other a rough broom finish.

The slabs are cast in a flat position with the muslin on the bottom form plate. A concrete mixture and wire mesh are placed on this. Over it is put a layer of pre-formed glass fiber and another layer of concrete. After setting the slabs are cured for two days in a chamber at 120-degree temperature and 100% humidity. Then they are further cured in the factory yard for ten days.

These slabs can be used as a curtain wall to be attached to structural iron or as a load-bearing wall, according to Owens-Corning Fiberglas Corporation, whose product is used for the center layer.

Glass is Benefitted
By Aid From Other Crafts

Combined Skills

Reprinted from "For Instance," American Cyanamid Co.

➤ Among the many achievements of the combined skills of chemists and engineers is the flotation process. With a unique series of chemicals and an ingenious flotation machine one can separate many metallic and nonmetallic compounds. Sulfur can be separated from a rayon spinning bath or from volcanic ash, and iron oxide can be removed economically from sand deposits. In seeming defiance of the law of gravity some heavier-than-water components of a mixture can be floated from a water slurry leaving the other components in the slurry. The flotation process has increased the value of our natural resources by converting unusable ores into useful materials and by beneficiating a variety of other materials so that they meet special requirements.

An interesting case is the beneficiation of certain deposits of sand used in the manufacture of glass. These sands are mixtures of quartz and feldspar, but the sand also contains about three to six parts of iron oxide to every thousand parts of sand. Iron imparts a green discoloration which is of no importance in low-grade glass but only a very small amount of iron can be tolerated for optical glass or the best glass tableware. With a flotation process the iron content of the sand was reduced sufficiently to meet the requirements for high quality glass.

Not content with this achievement the flotation experts also devised a method for separating the quartz from the feldspar. This provided the glass maker with quartz of very low iron content required for the manufacture of glass for special uses. The feldspar was also of particular interest in other types of specialty glass. And so the value of this sand was increased considerably by these combined skills.

Glass has become so commonplace that its important contributions to civilization elude the casual thinker. We put a thermometer in boiling oil or in a deep freezer without a moment's hesitation when we wish to know the temperature at either of these extremes but, from what material could we make the stem of the thermometer if we did not have glass? At present there is no satisfactory answer to this question.

When the pieces of glass which come from the hand of the lens maker are arranged in the proper manner, another Leeuwenhoek can rediscover the corpuscles in the blood or another Cajal can explore the structure of the human brain and study the axon and the dendrites which extend from the cell body of the nerves to receive and deliver the variety of impulses to which we respond. Through the glass in the microscope the wonder world of minutiae has been revealed to us. Again, thanks to glass, the telescope has revealed the almost inconceivable distances in our physical universe. It has provided facts

from which the mind of man may determine the nature if not the purpose of the world in which we live. And again, many of us could not enjoy the thoughts of others as expressed in the printed word if it were not for those glass products of the optician.

No one knows who the benefactor was that discovered glass making. Pliny's story of the discovery by Phoenician sailors about 5,000 B. C. is discredited at present for good technical reasons. There is evidence that the Egyptians made glass in the form of a glaze for stoneware about 3400 B.C., but their earliest known glass vessels belong to the period of 1500 B.C. They came into fairly extensive use about 1450 B.C. The Romans invented the blowpipe in the first century A.D. which stimulated developments in the vitric art. The magnificent Barberini vase, ca. 150 A.D., was made by superimposing layers of different colored glass then cutting the design in the upper layer. The vase was popularized many centuries later by that master craftsman of the potter's art, Josiah Wedgwood, in his beautiful "Jasper Ware." The glass industry was so important to the Venetians in the 13th century that they confined the glass makers on the island of Murano to preserve their trade secrets. It was the immigrant Venetian, Verzellini, who made Queen Elizabeth's wine glass and obtained a patent from her dated 1575. In 1947 one of his eight known goblets brought the highest price ever paid for a piece of English glass, $5,600.

It might be said that America's first glass factory at Jamestown in 1608 was also its first mint since its principal product was colored glass beads for trading with the Indians. Glass factories were working at Salem, Mass., in 1638 and in New York in 1654, but the fabulous "Baron" Stiegel added a touch of glamour to American glass at Manheim, Pa. His first glass pot was fired in October 1765 and when the sheriff sold his glass houses in 1779 his unique career in glass was ended.

The French gained supremacy in the production of flat glass by the discovery of the casting process. The supremacy is reflected in the Louis XIV Hall of Mirrors at Versailles. The American vitric industry, after repeated failures due to lack of experienced workmen and good raw materials, now leads the world in glass production as a direct result of chemical and engineering skills. But these same skills have produced a variety of organic plastics which not only offer keen competition to glass, they have actually replaced it for some purposes. However, glass and plastic are combined in safety glass to make riding behind the windshield somewhat safer.

From a moment's careful thought it is evident that civilization is the product of the combined skills of all humanity. It is also quite apparent from a glance through the pages of history that the character of civilization is determined by the relative emphasis placed on cultural or materialistic skill.

Vanadium, one of the rarest and most costly alloying elements in certain steel, imparts strength and toughness, and enhances flexibility in heat treating.

New Natural and Synthetic Adhesives Resist Moisture, Fungi, and Weather

Packaging Adhesives

Reprinted from FRONTIER

Armour Research Foundation of Illinois Institute of Technology

by ARTHUR E. GABRIEL

➤ SYNTHETIC resin adhesives have contributed much to the progress of modern packaging. Notable improvements in the quality, design, and durability of packages have resulted from phenomenal advances made in adhesives during the last decade. Many foods, chemicals, medicinals, military goods, and other commodities that formerly could not be transported without deterioration can now be shipped safely, and at reasonable packaging cost, to all parts of the world. Progress in the packaging field is steadily being made as new adhesives, films, and foils become available.

Prior to 1940, the number of glues or adhesives used in the packaging field permitted little variety. Since then that number has grown beyond even careful estimating. The older and more familiar glues, such as dextrine, starch, animal, casein, silicate of soda, blood, and soybean, are being replaced in certain applications by the new synthetic glues. However, they are not yet disappearing from today's market, nor is it expected that they will in the near future.

Last year some 300 million pounds of starches and dextrines and 40 million pounds of animal gelatin were used in glues for all purposes as compared to 60 million pounds of synthetic resin adhesives. The older glues offer certain significant advantages over most synthetic resin glues, particularly with regard to economy, ease of application, and quality of bonding to certain types of materials. On the other hand, synthetic resin glues generally possess much better water resistance, lower vapor transmission, more uniform quality, inherent resistance to organisms, and higher temperature resistance.

Competition from the newer adhesives has prompted research on the older glues to assure better quality and uniformity in addition to improving their resistance to moisture, fungi, and bacteria. Many consumers of animal or blood glues have complained of the variable characteristics of these glues from lot to lot. Not long ago, it was announced that a new process had been developed to produce animal glue of unusually uniform quality. Such a product will maintain, if not increase, the use of animal glue in industry.

The growth of the adhesive industry in the packaging field is demonstrated by the fact that today more than 400 different raw materials and chemicals are used in adhesive formulations. New industries could be devised which would permit full realization of new ideas for new prod-

ucts. Multiwall paper sacks and fiber containers, which have been very popular, could not have been developed if it were not for the newer adhesives.

Aluminum foil and other commonly used metals can now be cemented satisfactorily with new adhesives, opening up still larger possibilities for package design. About a year ago, a special filament tape was announced as a substitute for metal bands that would cut packaging costs for many customers. This tape incorporates a new type of construction to give it high strength with extreme thinness (180 lbs. per inch of width thickness of 10 to 11 mils). More will be heard and seen of this kind of tape in the future.

Another novel use to which adhesives have been put is in the palletizing of bags for shipment. The filled bags are stacked squarely in pairs on wooden pallets, each perpendicular to the adjacent pair, resulting in an interlocking arrangement. An adhesive spread between the bags prevents slipping, and the top layer of the palletized bags is steel strapped to hold the entire load firmly. Labor-consuming bag handling is thus reduced to a minimum and bag damage greatly decreased.

The development of containers is influenced and controlled by several fundamental factors of which durability, protection of the product, ease of handling, and economy are predominant. A good product in a poor container can receive consumer criticism which may be reflected by a decrease in future sales. Often, when sales drop, the cause is not at once obvious. It would be well, under such circumstances, for a manufacturer to make an investigation into the packaging program, for it may be discovered that the adhesive or laminating glue is the underlying cause. Perhaps a slight modification of the adhesive used will remedy the difficulty.

A progressive manufacturer will keep alert to the uses to which his goods are put and try to determine the ultimate storing and handling conditions practiced by the consumer.

Multiwall paper sacks and fiber and corrugated containers are still replacing, and will continue to replace, wooden boxes, barrels, crates, and steel drums for shipments of a wide variety of chemicals and commodities. The new paper and fiber containers have the advantages of being lighter in weight, more compact for storage, more easily handled, and lower in cost. The development of these new packaging products has been made possible largely by the new adhesives and coating materials that have been placed on the market.

Coating compositions, in some respects, may be considered as adhesives since a permanent coating must adhere well to the surface to which it is applied. Examples of these coatings are the vinyl resins, the cellulose derivatives, the acrylics, and the phenolic resins.

Heavy duty paper bags and fiber containers, used for the shipment of certain chemicals, cement, seeds, fertilizers, foods, drugs, etc., must withstand exposure to all sorts of climatic conditions, from tropical to polar, since the products they contain may be used in all parts of the world.

Where hygroscopic or chemically-sensitive materials are concerned, the first requisite for an acceptable package is moisture resistance. Asphalt has commonly been used as a laminating adhesive and moisture barrier for multiwall constructions, but it is subject to certain limitations.

A few of these limitations are low softening point, gradual flow at warm temperatures, and low-temperature brittleness. Also, the bond made between paper and asphalt is mechanical, not chemical or physio-chemical in nature, so that delamination will occur when the outer paper plies in the packaging construction absorb excessive moisture, causing sufficient swelling of the fibers to break the bond. High wet-strength Kraft papers (developed during the last war) diminish the moisture absorption and swelling of the fibers.

A better laminating material than asphalt, reclaimed rubber adhesive, was introduced some years ago. This material possesses a considerably higher softening point, greater strength properties, and a much lower brittle point. Pliofilm (rubber hydrochloride) has also been used as a laminating moisture barrier, but it is too expensive for the purpose.

One of the most successful laminating resins, recently developed for multiwall paper packaging, is polyethylene. Besides being waterproof, this resin remains flexible at low temperatures (as low as minus 65°F); it is non-toxic, odorless, alkali and acid resistant, chemically inert; and does not stiffen or crack with age. Because of its rather low softening point (about the boiling point of water), polyethylene can not be used in some applications.

However, its low softening point does permit heat sealing, which is advantageous in certain applications particularly in food packaging where air-tight seals are desired. Being chemically inert, polyethylene cannot be dissolved in solvents to form adhesive solutions at room temperatures, but it can be applied as a hot-melt adhesive. No practical adhesive capable of setting at temperatures below the softening point of polyethylene, has been developed to bond, with sufficient strength, polyethylene to itself or to normal materials used in packaging.

Polyethylene has been successfully hot-calendered on paper, thereby opening new fields to the paper converting industry. Polyethylene coated papers have just recently been used by some packaging companies, and such papers will win increasing popularity. These coated papers are used as liners for bags, fiber containers, corrugated boxes, and can be heat sealed air-tight after the product is packaged. Because polyethylene is inert and non-toxic, food, drugs, and chemicals can be shipped safely in such packages. In addition, corrosive and hygroscopic materials are protected by this liner.

During the past few years, polyethylene film has been used as an inner bag material which is somewhat more costly than the polyethylene coated paper liner particularly for large packing applications. The cost of polyethylene, still much more expensive than asphalt, will continue to drop toward the competitive price level of the cheaper resins. At present, however, this plastic is being allocated,

but, in its military role, polyethylene is entering into many types of packages.

Thermosetting laminating resins have not been used in multiwall paper bags because they are generally too brittle or stiff and relatively more expensive than thermoplastics (vinyl resins, animal glue, dextrines, etc.) from the standpoint of cost of raw materials and fabrication. As a class, thermosetting resins are resistant to water, oils, greases, most organic solvents, and organisms. They have been invaluable to the package manufacturer in increasing the wet strength of paper. One to five per cent urea resin or melamine resin added to the pulp has given marked increase in the wet strength properties of ordinary Kraft paper.

In addition to the packaging applications mentioned earlier, adhesives are important in spot sealing, labeling, bonding of plastics and metals, and in the manufacture of pressure-sensitive tapes.

Properly formulated animal glues have found numerous industrial uses. The chief disadvantages of animal glues are lack of moisture resistance and the fact that heat is required for the application of the glue. Successful attempts have been made to improve water resistance by including formaldehyde-liberating substances or other aldehydes. However, these agents must be added to the glue just prior to application, otherwise, the mixture will gel upon standing. Research along these lines is greatly needed for the development of a more practical glue that can be made water resistant. The outstanding feature of animal glue is its ability to form excellent bonds with many types of materials.

Casein, a processed product from milk, differs from animal glue in that it is capable of developing a fair degree of water resistance if properly formulated. Many useful adhesives have been made from casein, and improvements are continuing with this product. However, the slow rate of setting of such formulations has long been a serious disadvantage. Last year, a quick-drying casein base adhesive was announced for labeling glass containers. The bond to glass held up well after soaking in water at room temperature for two weeks.

Insect-repellant adhesives are proving valuable to cereal, flour, confectionery and other manufacturers troubled with insect infestation of packaged products. These adhesives have entered the market only within the last few years.

Although natural and synthetic rubbers are being allocated by the government, adhesives based on these rubbers offer a great deal of promise to the packaging manufacturer. Modifications of Buna N and Buna S rubbers with vinyl resins will gain increasing use in packaging as their price structure becomes more favorable.

Polysulfide rubbers (Thiokol) and modified forms thereof may be the answer to certain packaging problems where ordinary commercial adhesives cannot assist. Polysulfide resins can be bonded to steel and paper alike with excellent adhesion. Because of their objectionable odor, polysulfide resins can not be employed in applications where food or similar commodi-

ties are concerned. They are, at present, higher in cost than polyethylene or other common laminating resins.

The synthetic rubbers can be cured at moderately warm temperatures, and their products possess extremely good low-temperature flexibility, grease and oil resistance, insect and bacterial repellency, vapor and moisture imperviousness. Correctly formulated and cured, they will resist high temperatures without softening or undergoing deformation, even under stress. They might be used as laminating resins for multiwall bags or in fiber containers. Combinations of synthetic rubbers with natural or synthetic resins in latex or solution form may find future applications in moisture-proof flexible packaging for shipment of goods to any climate in the world.

Marked emphasis is being placed on the development of adhesives from polyvinyl acetate (a thermoplastic) in the form of water dispersions. Emulsion types are preferred to the solvent or hot-melt types because they are odorless, free from fire hazard, and do not require heating equipment. The emulsion types can also be thinned with water to give the proper consistency.

Polyvinyl acetate emulsions are compatible with other resin emulsions or rubber latices and with a large variety of plasticizers. They are useful for such difficult surfaces as moisture-proof cellophane, cellulose acetate, aluminum foil, and special coated papers similar to waxed glassine. When applied to cardboard, paper, or other highly absorptive materials these adhesives set up in a few seconds.

Industrially, polyvinyl acetate emulsion is used in cementing shut the flaps of cardboard boxes, since this adhesive affords many protective advantages along with moisture resistance and rigid setting as compared to the older glues, such as animal, starch, or dextrines. Small boxes have been packed at the rate of sixty per minute. Starch dispersions may be added to the emulsions to reduce cost, although polyvinyl acetate itself is one of the cheaper synthetic resins on the market. Rubber and resin emulsions can not be used to glue two non-absorptive surfaces together since water in the adhesive layer can not escape to form a completely dry bond.

The packaging manufacturer may be forced to use substitutes for materials which might soon become unavailable. Benzene, toluene, phenol, chlorine, and compounds derived from these materials are not allocated by the government: in particular, adhesives based on phenolic resins, vinyl chloride, vinylidene chloride, styrene, chloroprene (neoprene), synthetic rubbers, styrene copolymers, and alkyd resins will become increasingly short in supply.

Confronting all packaging manufacturers and designers is the question of how to select the proper adhesive from the maze of products on the market for their particular applications. Claims for the different proprietary adhesives are broad and often fail to indicate the expected performance or durability of the glue for given surfaces and climatic and service conditions.

Adhesive manufacturers can not afford to test their glues under all ex-

posure conditions and for all types of surfaces. They rely often on accelerated performance tests in their laboratory for an indication of applicability and durability. Some of these accelerated tests have proved to be of immense value as a research tool and a quick gage of actual performance characteristics. Various government agencies, adhesive manufacturers, universities, and trade and professional societies have assisted in the development of reliable laboratory tests. The American Society for Testing Materials maintains a special committee on adhesives (D-14 Subcommittee).

It is an expensive proposition for the packaging manufacturer to maintain a good adhesive testing laboratory. He can do better by farming out the testing or the research work whenever such problems arise in new packaging designs or in the plant. A private testing laboratory will be able to conduct the test work with a minimum of time and money while independent research organizations are in a position to do adhesive research and development. If the manufacturer is not certain whether his problem can be solved by a testing laboratory or a research organization, he would be wise to consult packaging associations or consultants in the field.

Many new adhesives formulations will enter the packaging field in the near future, but the continuing success and development of new adhesives of outstanding quality will depend in part on the initiative and willingness of packaging manufacturers to invest in adhesive research.

Spraying Corn Better Than Dusting

➤ GROUND RIG sprays of DDT may replace airplane dusting for corn earworm, a serious sweet corn pest.

O. G. Bacon, of the University of California College of Agriculture, in the third year of field trials against the pest, found that three applications of DDT with a ground rig give a very good control at less cost than the usual five to seven airplane dustings per season.

The ground rig used was equipped with a boom fitted with spray nozzles to spray two rows of corn. As it passes through the corn field it shoots the spray on both sides of the plant aiming at the area where the ears are growing. Commercial machines are capable of spraying as many as six rows of corn.

Several new insecticides were used in the tests but DDT gave the best results.

In general, airplane applications have not resulted in as good control as sprays applied by ground equipment. The airplane dustings do not always cover the corn silk, where the chemical is most needed. The problem of dust drift to adjoining fields makes airplane applications unsatisfactory at times.

Individual hand brushing with dust and individual hand spraying with a paint-type spray gun were also tested using DDT and other chemicals. Both methods of application gave good results but required a large number of workers to cover the fields quickly.

Improvements in Metals And Other Materials

Chemical Patents

Order patents by number from the Commissioner of Patents, Washington 25, D. C. Send twenty-five cents in money order, coin or Patent Office coupon for each patent ordered.

Improved Magnetic Metal

➤ MATERIALS having improved magnetic properties, particularly high magnetic permeability or low loss values, are made by adding beryllium oxide to crystalline ferrite materials in an invention awarded patent 2,579,267, the recipients being Humboldt W. Leverenz and Imre J. Hegyi, Princeton, N. J. Radio Corporation of America has been assigned the patent rights.

The material is made by heating together in an oxidizing atmosphere, such as oxygen or air, a finely divided iron oxide, beryllium oxide and an oxide of manganese, zinc, magnesium, nickel, cadmium or copper. Heating temperature is from 900 to 1500 degrees Centigrade.

Impurities in Air

➤ IMPURITIES in an atmosphere are quantitatively determined by an electric method with a device which is composed of two electrodes between which the air passes, there being an electric potential difference between the electrodes.

The device detects changes in the current between the electrodes due to the presence of impurities in the atmosphere passed between them. Determinations are made by passing at intervals pure air between the electrodes and comparing the changes in the current with those produced by a gas under test. The instrument is used to determine such impurities as gas, vapor, smoke and similar matter.

Inventor is William C. White, Schenectady, N. Y. Patent 2,579,352 was his award. General Electric, of the same address, has acquired the patent rights.

From Natural Gas

➤ SYNTHETIC gasoline and other hydrocarbons are made from natural gas by a process developed by Charles K. Mader, Cresskill, N. J., on which he received patent 2,579,843 with rights assigned to the M. W. Kellogg Company of Jersey City, N. J. The method is claimed to eliminate certain disadvantages in somewhat similar processes.

In this process, as in others, the methane that constitutes about 90% of natural gas, is converted to hydrogen and carbon monoxide. An object of this method is to decrease the temperature of preheating required in the conversion of methane to hydrogen and carbon monoxide by partial combustion with oxygen. A relatively large yield of carbon monoxide is obtained with a relatively small amount of oxygen.

Malleable Iron

➤ MALLEABLE iron with a greater range of usefulness is promised with a type containing boron and bismuth. The product is suitable for a greater range of thicknesses of sections in malleable iron castings. This annealable white iron casting contains small amounts of carbon, silicon and manganese. The small amounts of boron and bismuth added prevent the formation of primary graphite during solidification. Patent 2,579,452 was awarded to Harry A. Eckman and Henry W. Maack, Chicago, on this invention. Rights have been assigned to Crane Company of the same city.

Soybean Glue

➤ THE SOYBEAN, rapidly becoming one of America's principal agricultural crops, is the basis of a glue particularly suitable for the manufacture of high-grade low-cost fiberboard. It is for use primarily in the manufacture of industrial laminated paper containers such as cartons, boxes and barrels.

Inventors are Glen E. Babcock, Vernon L. Johnsen and Allan K. Smith, Peoria, Ill. Patent 2,580,391 was the award. Rights are assigned to the United States government as represented by the Secretary of Agriculture.

The glue is about 20 parts soy flour and soy protein, more of the flour being used as a rule than the protein. To this is added from 2.5 to 10 parts of a solution containing an ammonium resin and its alkali metal salt, a similar amount of saponified rosin and from 10 to 15 parts of an 8% sodium hydroxide solution. The fiberboard made with this glue has good water resistance and high strength.

Zinc-Coated Aluminum

➤ WIDER USES for aluminum are promised with an improved process of applying a protective zinc coating on it which brought patent 2,580,773 to Samuel Heiman of Philadelphia with rights assigned to Philadelphia Rust-Proof Company. Smooth, extremely adherent and uniform coatings on the aluminum are claimed by the inventor.

The coating is applied in an aqueous bath without the use of an electric current as employed in electroplating processes. The aluminum is cleaned to remove all of the surface oxide film, then dipped in a solution containing a water-soluble zinc salt and a water-soluble fluoride. Zinc sulfate and hydrofluoric acid are used. The same method may be used to coat aluminum with other metals, such as cadmium and tin, if proper chemicals are used in the bath.

Open-Hearth Steel

➤ THE MANUFACTURE of open-hearth steel is speeded up and improved by a process which utilizes oxygen gas to reduce the carbon content of the steel near the end of the heat and before the metal is tapped. The oxygen is introduced into the molten metal by means of one or more ferrous metal pipes connected to a source of high-grade oxygen. In older processes iron oxide in the form of iron ore is introduced into the molten metal near the end of the heat to oxidize the surplus carbon. Inventor of the new method is George V. Slottman, New York City. Patent 2,580,614 was his award. Rights are assigned to Air Re-

duction Company, Inc., also of New York.

Rubber Stabilizers

➤ Both natural and synthetic rubber are stabilized by the use of tin or antimony salts in an invention which brought patent 2,581,931 to Harry E. Albert, Akron, Ohio, with rights assigned to the Firestone Tire & Rubber Company. The stabilizers used are of the class consisting of the stannous and antimony salts of phenol-aldehyde reaction products, and phenol-ketone products.

Tests Steel Ropes

➤ Broken wires and other flaws in steel ropes caused by corrosion or abrasion are detected with an electromagnetic device which brought American patent 2,582,437 to two inventors in Poland, Mieczyslaw Jezewski and Ludger Szklarski, both of Krakow. Patent rights are assigned to Maurycy Brokman, New York City, and Waclaw Szukiewicz, Forest Hills, N. Y. It is designed particularly for testing steel cables in use in mining.

The detector device is an electromagnetic core in U-shape through which the rope while still in use runs. This magnetizes successive rope sections. The magnetic field of each magnetized section is controlled by its mechanical condition. A coiled wire device known as a solenoid is used to probe continuously the magnetic field. The current from the solenoid is amplified and used to make a recording.

Long-Life Rubber

➤ An improved process of giving both natural and synthetic rubber goods longer life by preventing deterioration due to heat, light, oxygen and flexing utilizes an improved antioxidant composition which includes a commonly used condensation product of an aliphatic ketone and an aromatic amine but includes also a synergist to improve their action.

A synergist is a chemical to cause the mixture of two reagents to give a greater total effect than the sum of their separate effects. The synergist used in this case is an alpha or beta naphthol and an hydroxy substituted benzene. Patent 2,582,695 was awarded to Marion W. Harman, Nitro, W. Va., for this process. Rights are assigned to Monsanto Chemical Company, St. Louis.

Improved Alloy

➤ An aluminum-magnesium casting alloy with stabilized physical properties is brought about by the addition of very small quantities of titanium and manganese. Wider use of aluminum-magnesium alloys is possible with this alloy which has consistent physical properties and greater tensile strength.

Physical properties of ordinary aluminum-magnesium casting alloys vary greatly and their physical properties are not improved by heat treatment methods now known. The new alloy contains from 3% to 8% magnesium, less than one-half per cent of titanium and maganese together, the rest being aluminum.

This invention brought Hugh S. Cooper, Cleveland Heights, Ohio, patent 2,583,473. Rights have been assigned to Acme Aluminum Alloys, Inc., Dayton, Ohio.

Proudly Presented

➤ THE LABORATORY, published by the Fisher Scientific Co. (Pittsburgh, New York, St. Louis, Washington, Montreal) features an article on the way "Greenhouse Laboratories" wage war on Viruses.

➤ USE OF Dow ion exchange resins to soften the water brought by the Colorado River Aqueduct to California's south coastal basin is explained under the title "River of Plenty" in the current issue of the Dow Diamond.

➤ ENTHONE, Inc., of New Haven, Conn., which has the Alumox 44 method of applying color to aluminum objects, also announces Water Displacing Liquid No. 51. The new liquid is claimed to be an improvement over earlier liquids for displacing water films from metal surfaces, to prevent tarnishing, staining and deposition of solid residues. Dr. Walter R. Meyer, president of Enthone, invites inquiries about either of his new products.

➤ How magnetic sound tape is made from acetate film is told in a recent issue of Celanese Plastics, published by the Celanese Corporation of America, 180 Madison Ave., New York 16, N. Y.

➤ KODAK Data Book on about 50 chemical preparations has just been issued, and is available from Eastman Kodak dealers at 50 cents.

➤ AMMONIUM sulfate, aluminum hydroxide and magnesium trisilicate are among the inorganic chemicals for which J. T. Baker Chemical Co. designed their new manufacturing and packaging plant at Phillipsburg, N. J. New penicillin production units with the latest in large-scale equipment are also featured there.

➤ WOOL bleached by hydrogen peroxide in a continuous process can be dyed satisfactorily in light shades if the proper precautions are taken according to chemists of the research department of the Buffalo Electro-Chemical Co. A study of the advantages of their hydrogen peroxide dry-in process is offered as Bulletin 29 of the Becco Sales Corporation, Station B, Buffalo 7, N. Y.

➤ VINYL CHLORIDE coverings for big machinery exposed to the weather were developed for the U. S. Army Ordnance Corps by the Plastics Division of the Monsanto Chemical Co. and the National Transparent Plastics Corporation, both of Springfield, Mass.

➤ LEATHER of better appearance and greater durability is promised by the Borden Company through use of their casein preparations, Protovac and and Casolac. Their bulletin "Borden Casein Products for Leather Finishing" tells how to get various finishes, weather-resistant, pliable, hard firm and others. This and special advice are available from the company's chemical division, 350 Madison Ave., New York 17, N.Y.

➤ GASES and light liquids can be analyzed and ratios of stable isotopes determined by a new mass spectrometer, Model 21-401, offered by the Consolidated Engineering Corporation, 300 N. Sierra Madre Villa, Pasadena 8, California.

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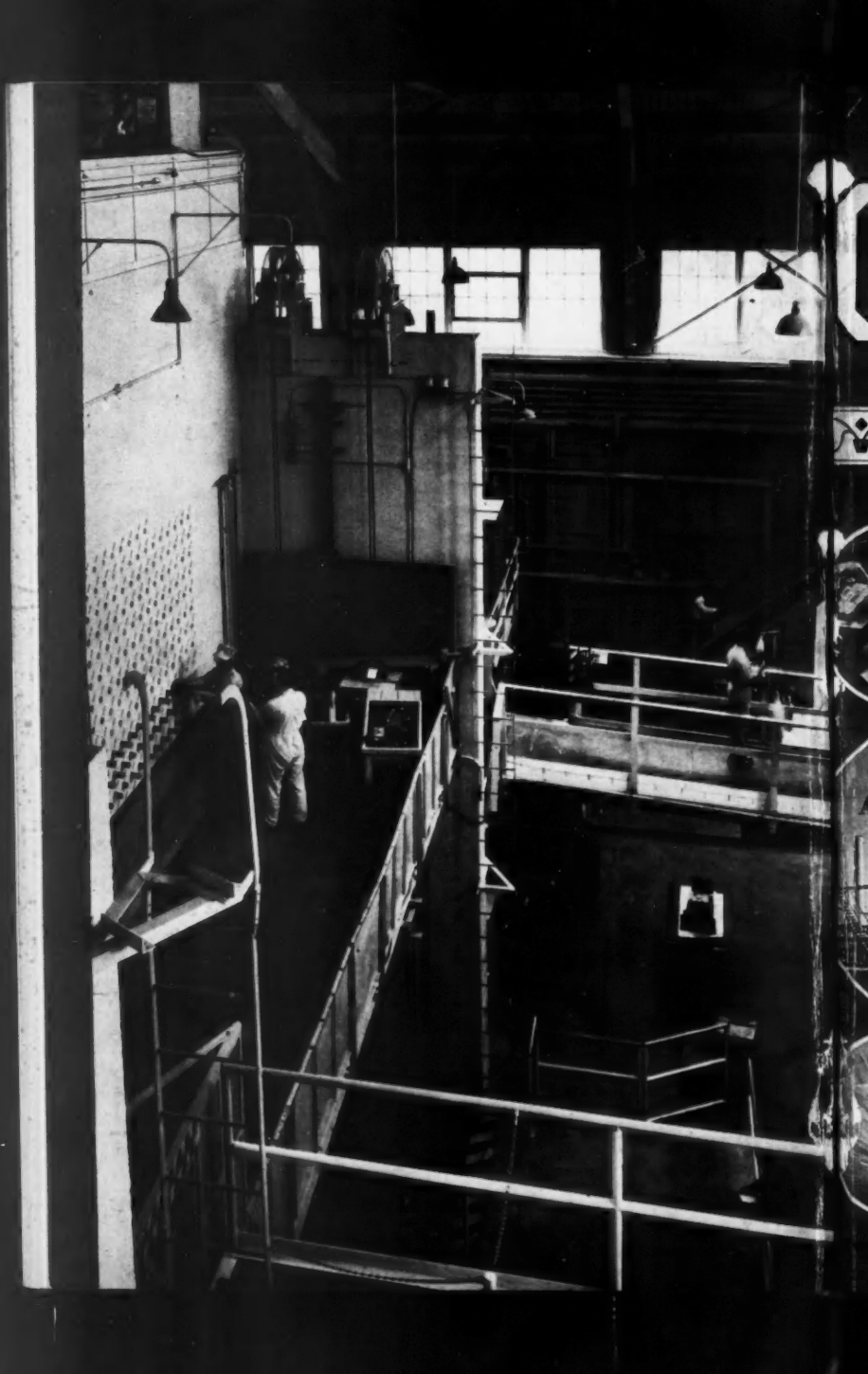
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